



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 5

230 SOUTH DEARBORN ST.

CHICAGO, ILLINOIS 60604

REPLY TO THE ATTENTION OF:

JAN 24 1990

5HR-12

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. Eugene Gillespie
Department of Energy Site Manager
P.O. Box 700
Portsmouth, Ohio 45661

Re: Time Frames for U.S. EPA
Review of U.S. DOE Quadrant II
Workplans

Dear Mr. Gillespie:

The United States Environmental Protection Agency (U.S. EPA) has conducted a preliminary review of the "Description of Current Conditions," and the "Quadrant II Work Plan" for the United States Department of Energy (U.S. DOE) Portsmouth Uranium Enrichment Complex. It has been determined that no major deficiencies exist which would inhibit U.S. EPA from thoroughly reviewing the above documents.

In order to alleviate schedule conflicts with the Ohio Environmental Protection Agency (OEPA), the U.S. Department of Energy (U.S. DOE) submitted the above referenced documents approximately eleven (11) months before the required submittal date specified in the October 25, 1989, Corrective Action Consent Order between U.S. EPA and U.S. DOE. Due to the large volume of material currently being reviewed by U.S. EPA concerning Quadrant I, U.S. EPA will not be able to complete review of the Quadrant II documents within thirty (30) days.

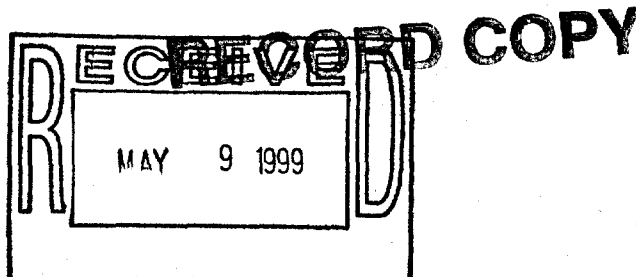
U.S. EPA is coordinating with OEPA to determine a date upon which both agencies will submit comments to U.S. DOE on the Quadrant II documents. This submittal date will be finalized between U.S. EPA, OEPA, and U.S. DOE at the February 1, 1990, monthly technical exchange meeting. If you have any questions regarding the above matter please contact James Saric at FTS 886-0992.

Sincerely yours,

William E. Muno

William E. Muno, Chief
RCRA Enforcement Branch

cc: Dick Snyder, MMES
John Rochotte, OEPA-SEDO





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November 22, 1989
EO-221-91

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Dear Madam and Gentlemen:

**QUADRANT II RCRA FACILITY INVESTIGATION WORK PLAN AND DESCRIPTION
OF CURRENT CONDITIONS**

Attached, please find the Quadrant II RCRA Facility Investigation Work Plan and Description of Current Conditions for the PORTS site for your review and approval.

If you have any questions or require additional information, please contact Melda Rafferty at (614) 897-5010.

Sincerely,

Eugene W. Gillespie
Eugene W. Gillespie
Site Manager
Portsmouth Enrichment Office

EO-221:Rafferty

Attachment:
As Stated

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M. A. Travaglini, ORO-Env. Restoration
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QUADRANT II
RCRA FACILITY INVESTIGATION
WORK PLAN

Prepared By:

Geraghty and Miller, Inc.
Environmental Services
Dublin, OH 43017

Under Portsmouth Contract 8M0050
Release 22

October 1989

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QUADRANT II RFI WORK PLAN

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EXECUTIVE SUMMARY

INTRODUCTION

The objective of the Quadrant II RCRA Facility Investigation (RFI) at the Portsmouth Gaseous Diffusion Plant (PORTS) is to acquire, analyze and interpret data which will:

- 1) characterize the environmental setting including ground water, surface water and sediment, soil and air;
- 2) define and characterize sources of contamination;
- 3) characterize the vertical and horizontal extent and degree of contamination of the environment;
- 4) assess the risk to human health and the environment resulting from possible exposure to contaminants; and
- 5) support the Corrective Measure Study (CMS) which will follow the RFI.

WORK PLAN STRUCTURE

Characterization of Environmental Setting

The site-wide environmental setting of PORTS is described in detail in the Quadrant I and Quadrant II Descriptions of Current Conditions. The additional monitoring wells and soil borings installed during the Quadrant II investigation will provide more detailed data concerning the environmental setting of Quadrant II including ground-water flow directions, aquifer characteristics, vertical and horizontal gradients and ground-water and surface-water quality.

Characterization of Wastes

All known waste and process substances that have been disposed of or used in Quadrant II have been identified on the Unit Data Sheets in Chapter 6 of the Quadrant II Description of Current Conditions. These wastes will be characterized in this investigation in terms of hazardous substance/waste classification, description of physical and chemical properties and migration and dispersal properties. This will be accomplished by waste sampling and analysis, reviewing published literature and using bench-scale data obtained during the Quadrant I investigations.

Characterization of Contamination

The primary objectives of contamination characterization are to identify the contaminant source(s); define vertical and horizontal rate and extent of contaminant migration; and delineate the vertical and horizontal concentrations of all hazardous constituents in the ground water, surface-water, surface-water sediments, soil and air. To accomplish this objective, a series of investigations will be conducted, one at each of the 16 units identified as requiring further data to meet the RFI objectives listed above.

To characterize surface-water and sediment contamination in Quadrant II, surface-water samples will be collected and analyzed for Federal Primary and Secondary Drinking Water Quality Standards, biological oxygen demand (BOD), chemical oxygen demand (COD), Appendix IX and radionuclide parameters; sediment samples will be analyzed for CLP Target Compound List parameters. No air sampling or analysis is planned for the Quadrant II investigation.

Each investigation of ground-water and/or soil contamination in Quadrant II will be conducted using a systematic, phased approach consisting of five steps. The investigation of certain units may require some modification of this approach to more appropriately address the specific nature of contamination at those units.

The five-step approach is as follows:

- 1) Samples will be obtained for analysis from a loose network of soil borings/monitoring wells at each unit.
- 2) If contamination is detected in step 1, the network of sampling locations will be expanded and refined in the area of the plume.
- 3) Once the location of the plume has been approximated in steps 1 and 2, monitoring wells located within the part of the plume with the highest contaminant concentrations will be sampled for Appendix IX (water) or Target Compound List parameters (soil) and radionuclide analyses. This step will identify all hazardous constituents and radionuclides present in the plume.
- 4) Following the identification of the hazardous constituents in step 3, additional sampling locations will be added, as needed, to define the vertical and horizontal extent and degree of contamination by those constituents.
- 5) After the extent and degree of contamination has been determined and the detailed environmental data acquired in steps 1 through 4 have been interpreted, the rate of contaminant migration can be calculated.

UNIT INVESTIGATIONS

A separate work plan has been developed for each of the 16 units in Quadrant II which require further investigation. The work plan for each unit investigation describes the number of wells, soil borings and sampling locations planned for each unit (Plates 1 and 2, Appendix A). Each work plan also details the methods of sampling and analysis which will be used during each unit investigation. Although a separate investigation is planned for each unit, data from all investigations will be integrated to develop a complete environmental characterization of Quadrant II.

X-230J7 East Holding Pond and Oil Separation Basin

To determine the extent of sediment contamination at this unit, three composite sediment samples from the holding pond and one composite sediment sample from the Oil Separation Basin will be collected. All samples will be analyzed with a field GC and submitted for CLP Target Compound List and radionuclide analyses.

X-633 Pumphouse and Cooling Towers

Seven monitoring wells will be installed in the vicinity of the X-633 facility to detect ground-water contamination in this area of Quadrant II: six wells in the Gallia and one well in the Berea. Nine soil borings will also be drilled in the area to determine whether of any soil contamination has occurred.

Ground-water samples from the wells will be analyzed for RCW additives and radionuclides. Soil samples from the wells and soil borings will be analyzed on-site with a field GC and a pH meter, and be submitted for laboratory analysis for chromium. Based upon the early analyses, selected soil samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings and/or monitoring wells may be installed, as needed, to define the extent of any contamination.

A study of the effects of cooling-tower drift on the hillside east of the cooling towers will also be performed. Ten soil samples will be collected and analyzed for chromium and zinc. Additional samples may be collected, as needed, to define the extent of contamination.

X-700 Chemical Cleaning Facility

Two Gallia wells will be installed west of the X-700 building to assess the degree of ground-water contamination there. Seven soil borings will be drilled on the east side of the building to evaluate the possibility of leakage from the process lines which connect the building to the X-701C Neutralization Pit. Gallia wells installed during investigations of the X-701C, X-705 and X-720 facilities will also provide data concerning the extent of ground-water and soil contamination in this area.

Ground-water samples from selected wells will be analyzed for Appendix IX and radionuclide parameters. Soil samples from the well and soil borings will be analyzed on-site with a field GC and a pH meter. Based upon the field-GC analyses, selected soil samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings and/or monitoring wells may be installed, as needed, to define the extent of any contamination.

X-700 TCE/1,1,1-TCA Outside Storage Tank

Three soil borings will be drilled in a semi-circle around the eastern side of the storage tank. Soil samples from the borings will be analyzed on-site with a field GC. Based upon the field-GC analyses, selected soil samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings may be drilled, as required, to define the extent of any contamination.

X-701 Northeast Biodegradation Plot

Six soil borings will be drilled within the former boundaries of the X-701 plot to define any soil contamination there. All soil samples will be analyzed with a field GC. Based upon these analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings may be needed to define the extent of contamination.

X-701C Neutralization Pit

Two soil borings will be drilled east of X-701C to define the extent of contamination in the area. If contamination is detected in the saturated zone, selected boreholes may be completed as monitoring wells. Soil samples from the borings will be analyzed on-site with a field GC. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings and/or monitoring wells may be installed, as needed, to define the extent of contamination.

X-705 Decontamination Building

To assess the extent of ground-water and soil contamination in the immediate vicinity of X-705 and within this area of Quadrant II, seven Gallia wells and one Berea well will be installed near X-705. In addition, Gallia monitoring wells installed during investigations of the X-700 and X-720 facilities will provide data concerning the degree of ground-water and soil contamination in this area. Ground-water samples from selected wells will be submitted for Appendix IX and radionuclide analyses. Soil samples from the wells and soil borings will be analyzed with a field GC and a pH meter. Based upon these analyses, selected soil samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings and/or monitoring wells may be installed, as required, to define the extent of any contamination.

X-705A Radioactive Waste Incinerator and X-705B Burnable Storage Lot

To define the extent of any shallow soil contamination by radionuclides, eight soil samples will be collected from the X-705A/B area using a manual soil auger. Samples will be composited to a depth of 2-feet below ground surface and submitted for radionuclide analysis. Additional borings may be augered, if necessary, to define the extent of soil contamination.

X-720 Maintenance and Stores Building

Five Gallia wells and one Berea well will be installed near the X-720 facility to assess the degree of ground-water and soil contamination in the area. Gallia wells installed during investigations of the X-700 and X-705 buildings will also provide data concerning ground-water and soil contamination in this area. Ground-water samples from selected wells will be analyzed for Appendix IX and radionuclide parameters. Soil samples from the well borings will be analyzed on-site with a field GC and a pH meter. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings and/or monitoring wells may be installed, as required, to define the extent of any contamination.

To characterize wastes stored in the neutralization pit located at the northeast corner of the building, two waste samples will be collected, one at the top and one at the bottom of the fluid column in the pit. Both samples will be analyzed on-site with a field GC and will be submitted for Appendix IX and radionuclide analyses.

X-744G Bulk Storage Building

Four soil borings will be drilled along the south side of the X-744G building. Soil samples collected from the borings will be analyzed on-site with a field GC and a pH meter. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings may be drilled, as needed to define the extent of any contamination.

X-744 Retrievable Waste Storage Area

Ten soil samples will be collected for the X-744 area using a manual soil auger. Soil samples will be composited to a depth of 2-feet below the ground surface and submitted for analysis of radionuclides. Additional borings may be augered, as needed, to define the extent of any soil contamination.

East Drainage Ditch and Little Beaver Creek

Six soil samples will be collected from the sides of the East Drainage Ditch using a manual soil auger. Six sediment samples will be collected from the bottom of the ditch, and ten sediment samples from Little Beaver Creek. All sediment and soil samples will be composited and analyzed on-site with the field GC. Selected samples will be submitted for CLP Target Compound List and radionuclide analyses.

Approximately ten surface water samples will be collected from Little Beaver Creek at locations corresponding to the sediment sampling locations. Selected water samples will be submitted for Appendix IX and radionuclide analyses, along with Federal Primary and Secondary Drinking Water Quality Standards, Biological Oxygen Demand and Chemical Oxygen Demand.

X-700 Chemical and Petroleum Storage Containment Tanks

Two soil borings will be drilled adjacent to the tanks to detect any contamination originating from them. Soil samples from the borings will be analyzed on-site with a field GC. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings may be drilled, as required, to define the extent of any contamination.

To characterize wastes stored in the tanks, two samples will be collected, one from the top and one from the bottom of the fluid level in each tank. Field-GC, Appendix IX and radionuclide analyses of all samples will be performed.

Process Lines from X-700 and X-705

Four soil borings will be drilled near the process lines to determine if contaminants have leaked from the lines. Soil samples collected from the borings will be analyzed on-site with a field GC. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional borings may be drilled, as required, to define the extent of any contamination.

Two backhoe pits will be excavated along the process lines to allow for visual inspection of the lines and detailed sampling of the backfill around the lines. All samples will be analyzed on-site with a field GC and a pH meter. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional backhoe pits may be excavated, as needed, based on field observations.

Sanitary Sewer System and X-614P Northeast Sewage Lift Station

Twelve soil borings will be drilled adjacent to the sanitary sewer lines in Quadrant II. An additional boring will be drilled adjacent to the X-614P lift station. Soil samples from the borings will be analyzed on-site with a field GC and a pH meter. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. If contamination is found in samples from the saturated zone, selected boreholes may be completed as wells. Additional borings and/or monitoring wells may be installed, as needed, to define the extent of any contamination.

Storm Sewers D and E (East-Central Drainage Sector)

Six soil borings will be drilled adjacent to the storm sewers in Quadrant II. Soil samples from the borings will be analyzed on-site with a field GC. Based upon the field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. If contamination is found in samples from the saturated zone, selected boreholes may be completed as wells. Additional borings and/or monitoring wells may be installed, as needed, to define the extent of any contamination.

GROUND-WATER FLOW AND TRANSPORT MODELING

Data collected during the Quadrant II investigation will be integrated and incorporated into the existing flow model constructed for the site. The objectives of the modeling effort are to; 1) provide an estimate of the rate of contaminant migration from any sources, 2) guide additional data collection activities, 3) provide an assessment of the contaminant migration pathways, 4) provide additional quantitative analysis to support the Quadrant II risk assessment, and 5) provide input to support the selection of remedial alternatives or interim corrective measures.

RISK ASSESSMENT WORKPLAN

The risk assessment workplan for Quadrant II describes the process that will be used to assess risks to human health and the environment associated with potential, current and future exposures to on- and off-site substances released from PORTS.

BENCH-SCALE STUDIES

Bench-scale studies will be performed to determine the attenuation capacity of the geologic media in Quadrant I with respect to contaminants identified at PORTS. Studies will also be performed to determine the effectiveness of biological attenuation on contaminants present at PORTS. As there is little variation in geologic media at PORTS, the results of these studies will be applicable to the Quadrant II RFI.

REPORTING

Following completion of the investigation, a final Quadrant II RFI Report will be submitted for review. During the investigation, progress reports will be submitted to OEPA and USEPA on a monthly basis. Each Monthly Progress Report will include a brief summary of progress, results, problems encountered, changes to the work plan, contacts with the public, estimates of the percentage of work completed, and projections of work to be done in the next month.

1. INTRODUCTION

1.1 Background

The Portsmouth Gaseous Diffusion Plant (PORTS) is owned by the U. S. Department of Energy (DOE) and operated by Martin Marietta Energy Systems, Inc. (MMES). This document was prepared by Geraghty & Miller, Inc. (G&M) for MMES. It is submitted in accordance with the requirements and schedules specified in the Findings and Orders issued by the Director of the Ohio Environmental Protection Agency (OEPA) on November 22, 1988 (effective December 1, 1988), the Consent Decree issued by the Ohio Attorney General's office on August 29, 1989 and with the RCRA Section 3008(h) Consent Order drafted by the U.S. Environmental Protection Agency, Region V (USEPA) on September 29, 1989.

The Quadrant II Description of Current Conditions is submitted with this document as specified in the orders listed above.

1.2 Purpose of This Investigation

The purpose of the RCRA Facility Investigation (RFI) at the Portsmouth Gaseous Diffusion Plant (PORTS) is to acquire, analyze and interpret data which will:

- 1) characterize the environmental setting including ground water, surface water and sediment, soil and air;
- 2) define and characterize sources of contamination;
- 3) characterize the vertical and horizontal extent and degree of contamination of the environment;
- 4) assess the risk to human health and environment resulting from possible exposure to contaminants; and

- 5) support the Corrective Measures Study (CMS) which will follow the RFI.

1.3 Organization of This Work Plan

An introduction to the environmental setting and extent of known, suspected and potential contamination at PORTS is provided in the Quadrant II Description of Current Conditions which is submitted with this Work Plan as a separate report. As is discussed in the Quadrant II Description of Current Conditions, much of the characterization of the plant-site environment has been completed. There are, however, some areas which will require additional work; a discussion of this additional work is presented in Chapter 2 of this Work Plan. Chapter 3 presents a plan to complete the physical and chemical characterization of wastes. Chapter 4 includes a discussion of the conceptual approach to the characterization of contamination, then presents sixteen investigation work plans, one for each area of known, suspected or potential contamination in Quadrant II. Chapter 5 consists of a plan for ground-water flow and transport modeling. A plan to conduct a risk assessment for Quadrant II is presented in Chapter 6. Chapter 7 briefly discusses the investigation analysis and final report. Chapter 8 presents a discussion of Quadrant I laboratory and bench scale studies and Chapter 9 enumerates reporting requirements. Appendix A contains the base maps illustrating the proposed investigations in Quadrant II. Appendix B contains a discussion of methodology used for site preparation for field-GC analyses during the investigation.

1.4 Quality Assurance/Quality Control

The Quality Assurance/Quality Control Program will follow the procedures outlined in the RFI General Plan. As part of the effort to obtain accurate and representative data, field procedures for environmental data collection at PORTS will follow the guidelines presented in Volume II (Appendix B) of the Quadrant I Work Plan.

2. CHARACTERIZATION OF ENVIRONMENTAL SETTING

2.1 Introduction

The characterization of the site-wide environmental setting at PORTS is nearly complete and is presented in the Quadrant I and Quadrant II Descriptions of Current Conditions. Greater detail obtained during the quadrant investigations will be integrated into the comprehensive characterization of the plant-site environmental setting. Additional work needed to refine the general characterization of the plant site will be discussed in the remainder of this chapter.

2.2 Hydrogeologic Setting

2.2.1 Introduction

The hydrogeologic setting has received a great deal of attention in previous investigations and has been extensively defined as a result of the recent RCRA Ground Water Quality Assessment of the X-701B site. A thorough discussion of these investigations is provided in the Quadrant II Description of Current Conditions and will not be repeated here. Additional information needed to characterize the plant-site hydrogeologic setting will be discussed in the following section.

2.2.2 Additional Characterization

2.2.2.1 Ground-Water Flow Modeling

Ground-water flow modeling will be an integral part of this RFI, both in the characterization of the environmental setting and in the characterization of contamination. Chapter 5 of this work plan presents a detailed discussion of how modeling will be used in the RFI.

2.2.2.2 Attenuation Capacity of Gallia and Minford

The attenuation capacity of a geologic unit is a function of its sorptive capacity, permeability and other physical characteristics in addition to chemical and biological processes. This parameter will be addressed as part of the Quadrant I RFI. Information obtained during that study can be utilized throughout PORTS, as neither the Gallia nor Minford exhibit any significant lateral variations at the plant site. Consequently, no further analyses of these parameters are planned for the Quadrant II RFI.

2.3 Soils

Since many of the individual investigations at PORTS focus on soil contamination and/or chemical interaction with soil components, it is necessary to define the physical, chemical, and mineralogical properties of the unconsolidated material at the site. Detailed soil analysis will be performed as part of the Quadrant I RFI, including soil classification, hydraulic conductivity, moisture content, cation exchange capacity (CEC), and numerous other parameters. In addition to defining soil properties, the Quadrant I RFI will establish background levels for inorganic and organic compounds. Because the Gallia and Minford are relatively homogeneous at PORTS, data obtained during the Quadrant I RFI can be incorporated into the Quadrant II RFI.

2.4 Surface Water and Sediment

2.4.1 Introduction

There are three holding ponds in Quadrant II: the X-701B Holding Pond, the X-230J7 East Holding Pond and the Oil Separation Basin associated with X-230J7. X-701B discharges into the East Drainage Ditch which carries the effluent (and any surface-water

runoff) to the East Holding Pond. The X-230J7 holding pond discharges into Little Beaver Creek.

The stream bed of Little Beaver Creek is 10 to 20 feet wide and seldom contains more than two feet of sediment. Gravel, sand, and clay deposits are common, although measurable accumulations of fine-grained clastics are generally restricted to small pools and eddies. Little Beaver Creek flows into Big Beaver Creek approximately 1.5 miles northwest of the site. The confluence of Big Beaver Creek with the Scioto River is located roughly 2 miles due west of PORTS.

2.4.2 Additional Characterization

Surface water and sediments in Little Beaver Creek will be sampled from the East Drainage Ditch to the northwest boundary of the property. Sediment-water pairs will be taken at each location to allow comparison of sediment contamination and aquatic chemistry. To establish baseline chemistry, an additional sample will be taken upstream from the East Drainage Ditch. Details of this sampling are presented in the work plan for the East Drainage Ditch and Little Beaver Creek (Section 4.6.14).

The surface-water samples will be analyzed for Federal Primary and Secondary Drinking Water Quality standards, for biological oxygen demand (BOD) and for chemical oxygen demand (COD). Selected surface water samples will also be analyzed for Appendix IX and radionuclide parameters. The sediment samples will be analyzed for CLP Target Compound List parameters. Sampling procedures will follow the protocols presented in Appendix B of the Quadrant I Work Plan.

2.5 Air

Climate, wind direction and ambient air quality monitoring results are provided in the Quadrant I Description of Current Conditions. No additional baseline air characterization is necessary.

3. CHARACTERIZATION OF WASTES

3.1 Introduction

All waste and process substances disposed of or used in Quadrant II have been identified on the Unit Data Sheets in Chapter 6 of the Quadrant II Description of Current Conditions. Quadrant II waste characterization will include hazardous classification, description of physical and chemical properties, and nature of migration and dispersal properties. This will be accomplished in a manner similar to the approach used to summarize waste and process units in the Quadrant II Description of Current Conditions; "Waste Constituent Data Sheets" will be prepared for each waste compound present in Quadrant II. The approach to the compilation of these data sheets is discussed below.

3.2 Approach

The primary task in the characterization of wastes in Quadrant II will be to describe their properties. To accomplish this a review of published literature will be conducted which should provide much of the required information. A primary source of information will be the Material Safety Data Sheets (MSDS's) from the Chemical Hazard Response Information System (CHRIS) for each waste constituent. The MSDS's provide physical and chemical properties, National Fire Protection Association hazardous classifications, and health effects (Immediate Danger to Life and Health - IDLH Values) as well as other pertinent information. Additional published sources will be reviewed, as needed.

At units where waste is accessible, the material will be sampled and analyzed to obtain quantitative data regarding the compounds present at the facility. Several of the individual unit investigation work plans presented in section 4.6 include plans to sample and analyze wastes. Once waste components have been

identified, they will be added, if necessary, to the list of Quadrant II wastes for which literature reviews are being conducted.

Most of the wastes in Quadrant II occur in association with other compounds. As a result, their physical and chemical properties (particularly those affecting migration and dispersal) may be different from those of the individual constituents. To account for these variations, data from the bench-scale studies performed in Quadrant I will be incorporated into the Quadrant II study. Additional bench-scale studies are not required because the soil at PORTS is subject to only minor lateral variations.

All available data regarding the wastes in Quadrant II will be compiled onto "Waste Constituent Data Sheets" which will be similar in format to the Unit Data Sheets in Chapter 6 of the Quadrant II Description of Current Conditions.

4. CHARACTERIZATION OF CONTAMINATION

4.1 Introduction

The characterization of contamination in Quadrant II will require the collection of pertinent data to identify the contaminant source(s), define vertical and horizontal migration rates, determine the extent of contamination, and delineate the vertical and horizontal concentrations of all hazardous constituents in the ground water, surface water, sediments, soil and air.

The areas to be investigated have been identified in the Quadrant II Description of Current Conditions based on an analysis of known, suspected and potential contamination. The next two sections of this chapter discuss the conceptual approach to the characterization of contamination. Ground-water flow and transport modeling is discussed in Section 4.4 and in Chapter 5. Inspection and testing of underground storage tanks to identify any tanks which may require investigation will be addressed in Section 4.5. Finally, Section 4.6 presents unit-by-unit work plans to characterize contamination at those areas identified in the Quadrant II Description of Current Conditions as requiring investigation.

4.2 Conceptual Approach

4.2.1 Sources of Contamination

In areas where the source of contamination is accessible without increased risk to human health or the environment (i.e., open impoundments, sludge piles and/or ditches where contaminants have been introduced) the sources will be sampled directly and submitted to a laboratory for the Contract Laboratory Procedures

(CLP) Target Compound List or for Appendix IX analysis. (See discussion of CLP Target Compound List in Section 4.3.2 of this report.) These analyses will identify potential contaminants present at each specific source.

4.2.2 Ground Water and Soil

Characterization of contamination of the ground water and soil in Quadrant II will be carried out using a similar, phased approach at each unit to be investigated. This approach consists of five steps:

- 1) Soil borings and/or monitoring wells will be drilled in a loose network around the unit. Samples of soil will be collected every two feet for field gas-chromatograph (field GC) analysis for volatile organic compounds (VOC's). All soil samples will be saved for possible future analyses. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements. Upon completion and surveying of each monitoring well, ground-water samples will be collected for field-GC analysis for VOC's. VOC analysis should provide a viable first indication of contamination, as virtually all waste units on the site are associated in some way with solvent use. In areas where solvents are not likely to be present, a brief list of other possible contaminants will be added to the analytical parameters (for example, chromium in association with the X-633 cooling tower).
- 2) If a plume is located, the network of soil borings and/or monitoring wells will be refined in the plume area. Subsequent sampling and field GC or laboratory analysis will yield a semi-quantitative picture of the size, shape and contaminant concentrations in the plume. If no plume

is located, Appendix IX and radionuclides analyses will be conducted on ground-water samples taken downgradient from the unit. If there is reason to believe that soil may be contaminated, CLP Target Compound List analyses will be performed in areas where the contamination is suspected.

- 3) Once the extent of the plume is defined qualitatively, Appendix IX and radionuclides analyses will be performed on water samples and CLP Target Compound List analyses will be performed on soil samples from the area where contaminant concentrations are highest.
- 4) Once the hazardous constituents in the plume have been identified, additional sampling points will be chosen, if necessary, to define quantitatively the extent of contamination and to determine the horizontal and vertical concentrations of all hazardous constituents identified.
- 5) Given the extent and degree of contamination and the detailed environmental data acquired in phases 1 through 4 above, the rate of contaminant migration can be calculated.

In each phase of this approach, all data relative to the environmental setting of the area being investigated will be integrated into the characterization of both the plant-wide and the unit-specific environmental setting. The procedures used in this approach are discussed in greater detail in Section 4.3 of this report.

4.2.3 Surface Water and Sediments

Surface water and sediments will be sampled in Little Beaver Creek and sediment samples will be collected from the East Drainage Ditch. As these streams are small, sampling will be limited. Sampling for contamination characterization will be conducted in conjunction with sampling for environmental characterization, as described in Sections 2.4 and 4.6.14 of this report.

4.2.4 Air

Ambient air-quality sampling and analysis is already in place at PORTS, both on- and off-site. The results of this study are presented in the Quadrant I Description of Current Conditions.

4.3 Field and Laboratory Analysis Strategy

4.3.1 Field Gas-Chromatograph Analysis

In general, all soil, sediment and ground-water samples will be analyzed using a portable field gas chromatograph (field GC). This will allow an immediate determination of the presence of VOC's as an alternative to waiting 4 to 8 weeks for laboratory results. Data from the field GC will allow rapid field decisions to be made concerning the investigation of the spatial distribution and type of contamination at each unit. Based on this information, well and boring locations can be selected more efficiently to define the extent of contamination while all field equipment and personnel are at the site. In addition, samples can be screened to limit unnecessary laboratory submissions or to indicate the need for additional laboratory analyses. Field-GC analyses will be checked by submitting duplicates (10% of samples) to the laboratory for analysis. Water samples from all new monitoring wells will be collected and sent to a laboratory for final VOC and radionuclide

analysis at the completion of the field investigation. A detailed discussion of the methods and procedures used to conduct the field-GC analyses is presented in Appendix E of the Quadrant I Work Plan. A discussion of soil preparation methodology for field-GC analysis is presented in Appendix B of this Work Plan.

4.3.2 Laboratory Analyses of Soil and Sediment Samples

Based on site-specific criteria, laboratory analyses of soil and sediment samples will be selected from the following:

- 1) radionuclides (total uranium, total alpha, total beta and technetium beta);
- 2) VOC's (SW-846 Method 8240);
- 3) site-specific parameters based on the known or suspected contaminants at the unit; and
- 4) the Contract Laboratory Program (CLP) Target Compound List will be used when the potential contaminants are unknown.

Selected samples from each unit will be analyzed for radionuclides. All samples obtained in the field will be screened with a radiological survey meter at the time of sample collection. These analyses are required because of the nature of the PORTS facility and the need to define all radionuclide contamination at the plant site.

Laboratory VOC analyses of some soil samples will be utilized in most unit investigations as a QA/QC check on the field-GC results and to provide additional data concerning the lateral and vertical extent of soil contamination. The VOC analysis will be followed by sampling in the most contaminated areas identified (for

the more extensive CLP Target Compound List) to obtain a comprehensive characterization of the soil contaminants.

The comprehensive analysis of soils and sediments will be conducted utilizing SW-846 methods. The substances selected for analyses are those listed in the Scope of Work for the Contract Laboratory Program. These lists are entitled the Inorganic Target Analyte List (ITAL) and the Target Compound List (TCL). The Target Analyte List for the Inorganic Scope of Work includes 23 metals and cyanide. The Target Compound List for the Organic Scope of Work includes 34 volatile organic compounds, 65 semivolatile compounds, 19 pesticides and 7 PCBs. In addition, a literature search will be conducted to identify all Gas Chromatograph/Mass Spectrometer peaks which are not included on the TCL. The target compound lists were designed for analyses performed on samples obtained from known or suspected hazardous waste sites. The selected SW-846 methods, the ITAL, and TCL are provided in Appendix D of the Quadrant I Work Plan. Level III reportables will be required of the laboratory conducting the analyses (Appendix B of Quadrant I Work Plan, ESP-700). Throughout this Quadrant II Work Plan these two lists will be referred to collectively as the CLP Target Compound List.

4.3.3 Soil Sampling Using a Continuous Split-Spoon Sampler

Throughout the Quadrant II RFI, continuous split-spoon samples will be collected from all well and soil borings. This allows for the identification of many lithologic and soil features during drilling. The number of blows per unit depth will be recorded to add to the geotechnical soils data already available for the site. The split-spoon samples will be collected using standard techniques outlined in Appendix B of the Quadrant I Work Plan.

4.4 Ground-Water Flow and Transport Modeling

Ground-water flow and contaminant-transport modeling will be an integral part of the Quadrant II RFI, both in the characterization of the environmental setting and in the characterization of contamination. Chapter 5 of this work plan presents a detailed discussion of how modeling will be used in the Quadrant II RFI.

4.5 Underground Storage Tanks (UST's)

Prior to conducting remedial investigations with respect to underground storage tanks, each tank must first be integrity tested to determine if leaks are present. A remedial investigation before this testing would be premature. An inspection and testing plan is currently being developed. Following tank inspection and testing, investigations will be conducted if required to determine the extent of contamination. Any remedial measures implemented at this site will be in accordance with 40 CFR Part 280 Subtitle I. A summary of underground storage tanks is provided in Chapter 6 of the Quadrant II Description of Current Conditions.

4.6 Investigation Work Plans for Specific Units in Quadrant II

4.6.1 Introduction

Presented in the next eighteen sections are a tentative investigation schedule, and individual work plans for each of the units identified in the Quadrant II Description of Current Conditions as requiring investigation. The order of presentation of these work plans is alpha-numeric and does not represent the investigative priority.

The RFI General Plan discusses an overall data-collection strategy and presents various general investigative techniques. The Quadrant I RFI Work Plan describes the site-specific procedures to be used in this investigation (Appendices B, C, D, E and F).

Appendix B of the Quadrant I Work Plan, Environmental Surveillance Procedures (ESP), presents the Quality Assurance/Quality Control (QA/QC) protocols for all environmental data collection during the RFI. The ESP manual was developed to provide a consolidated source of requirements, instructions and information on the subjects of data gathering and sampling and analysis for environmentally related data collected at MMES facilities. All sections, except section 300, are generic in nature in that they cover topics relevant to all sampling activities. Section 300 contains the individual sampling protocols to be followed in the field.

The following list matches each field investigation task with its corresponding section in Appendix B of the Quadrant I RFI and Appendix B of the Quadrant II RFI Work Plan. Unless otherwise indicated in the text of the following unit-specific work plans, all field procedures and protocols used to complete the unit investigation are those presented in these appendices. Unit-specific modifications of the protocols in Appendix B of the

Quadrant I RFI are presented in Appendices C, D, E, and F of the Quadrant I Work Plan.

<u>Task</u>	<u>Section</u>
Drilling, Soil Sampling, Rock Coring and Monitoring-Well Installation and Development	Appendix E, RFI General Plan Appendix B, ESP-600, 303-1 through 303-6 and Appendix C, Quadrant I RFI Work Plan
Field Measurement Procedures	Appendix B, ESP-307-1 through 307-7, Quadrant I RFI Work Plan
Ground-Water Sampling Procedures	Appendix B, ESP-302-1 through 302-5, Quadrant I RFI Work Plan
Surface Water Sampling Procedures	Appendix B, ESP-301-1 through 301-5, Quadrant I RFI Work Plan
Sediment Sampling Procedures	Appendix B, ESP-304, 308-1, and Appendix C, Quadrant I RFI Work Plan
Field Procedures Quality Control	Appendix B, ESP-400, Quadrant I RFI Work Plan
Soils/Sediment Laboratory Analysis	Appendix B, ESP-700 and Appendix D, Quadrant I RFI Work Plan
Chain of Custody Procedures	Appendix B, ESP-500, Quadrant I RFI Work Plan
Sample Preservation and Container Materials Equipment and Materials Decontamination	Appendix B, ESP-701, Quadrant I RFI Work Plan, Appendix B, ESP-900 and 901
Field GC Methodology	Appendix E, Quadrant I RFI Work Plan and Appendix B, Quadrant II RFI Work Plan
Soil Gas Geochemical Investigation Procedure	Appendix G, Quadrant I RFI Work Plan
Methodology for Field Determination of Soil pH	Appendix B, Quadrant II RFI Work Plan

4.6.2 Tentative Schedule of Investigation Activities

The OEPA and USEPA orders described in Section 1.1 of this work plan set a deadline for completion of all field work, interpretation and report preparation twelve months after approval of the work plan. This will require that progress be made on all unit investigations immediately upon approval of the work plans. A tentative schedule of investigation activities is presented in Figure 4.4.

4.6.3 X-230J7 East Holding Pond and Oil Separation Basin

4.6.3.1 Unit Description

The X-230J7 East Holding Pond was constructed in 1981 to control sedimentation resulting from storm runoff. Flow through the pond averages 1.1 million gallons per day. Oil booms direct waste oil to a secondary recovery basin, although the amount of recoverable waste oil is insignificant under normal conditions.

The East Holding Pond accepts flow from the East Drainage Ditch. The ditch receives effluent from the D and E storm sewers, and also received material from the X-701 Biodegradation Plot from August 1973 to September 1974. Effluent from the X-701B Holding Pond was discharged to X-230J7 from 1953 until the deactivation of X-701B in November 1988.

Potential contaminants in X-230J7 include caustic soda, nitric acid, sulfuric acid, uranium, sodium biferuoride, pyranol and various organic compounds. The East Holding Pond is listed in the USEPA and OEPA Consent Orders as requiring investigation.

4.6.3.2 Unit Investigation

Anticipated Site Geology

The thickness of geologic units in the eastern portion of the plant site is notably uneven. Individual units exhibit variations in thickness of more than 10 feet within individual well clusters. The thickness of the Minford clay ranges from 0 to 10 feet in this area. The Minford silt ranges from 0- to 19-feet thick, and exhibits a general trend of thinning to the east. The variable thickness of the Minford is primarily related to topography. The Minford is thicker on higher ground and thins toward drainage features, such as the East Drainage Ditch and the X-230J7 Holding

Pond, which lie at or near the bedrock surface. The Gallia occurs at depths of roughly 25 to 30 feet. The Sunbury Shale makes up the uppermost bedrock surface and exhibits an approximate thickness of 15 feet.

Ground-Water Quality and Flow Directions

Water-level data from monitoring wells in the vicinity of X-230J7 indicate that ground water in the Gallia and Berea flows eastward toward Little Beaver Creek (Figures 4.2 and 4.3). Ground-water samples were collected from these wells during November and December of 1988 as part of the Ground Water Quality Assessment of the X-701B Water Treatment Facility. These samples were analyzed for VOC's and radionuclides. Laboratory results show that X-230J7 is located near the eastern margin of the contaminant plume which originates at X-701B. Contamination is primarily limited to the southern side of X-230J7, although TCE was detected northeast of the Oil Separation Basin (701-16) at a concentration of 59 ppb.

Sediment Sampling

Four sediment samples will be collected at X-230J7: three from the holding pond and one from the Oil Separation Basin (Plates I and II, Appendix A). The samples will be obtained using a floating platform with a specially designed sediment sampler in accordance with the sampling procedures described in Appendix C of the Quadrant I RFI Work Plan. Samples will be collected from the sediment-water interface to the base of the sediments. A single, composite sample will be collected at each location and submitted for CLP Target Compound List and radionuclide analyses. In addition, field-GC analyses will be conducted on the sediment samples to obtain a preliminary determination of the presence of any VOC's.

Data obtained from the investigation of the East Drainage Ditch and Little Beaver Creek (See Section 4.6.14) will enhance the characterization of X-230J7.

4.6.4 X-633 Pumphouse and Cooling Towers and RCW System

- X-633-1 Recirculating Water Pump House
- X-633-2A Cooling Tower
- X-633-2B Cooling Tower
- X-633-2C Cooling Tower
- X-633-2D Cooling Tower

4.6.4.1 Unit Description

The Recirculating Cooling Water (RCW) System removes the heat of compression from the process gas, along with waste heat from a few auxiliary processes, and dissipates this energy to the atmosphere. A network of piping transports RCW under high pressure between the process buildings and the cooling towers. The piping is constructed of steel, 20, 42 or 72 inches in diameter. The depth to the base of the RCW piping backfill averages from 6 to 12 feet. The heat exchange from the compression or uranium hexafluoride involves a double-loop (primary and secondary non-contact) system to minimize the possibility of exposure of cooling water to the process gas. The primary heat exchange medium, Freon-114, vaporizes as it absorbs heat. Coolant vapor is collected with a manifold, liquified at a non-contact, water-cooled condenser, and returned to the evaporators. The condenser cooling water is routed to the cooling towers.

The Recirculating Cooling Water (RCW) system in Quadrant II includes a recirculating water pumphouse (X-633-1), three banks of cooling towers with associated basins and two uncovered basins.

The cooling towers utilize a forced-draft, cross-flow system that dissipates heat from the recirculating water by bringing it into direct contact with cool atmospheric air. The heated air is discharged at the top of the tower and the cooled water is collected in the basin below the tower. To maximize cooling, the water is broken into droplets to increase its surface area as it

falls through the tower. Some of these droplets (drift or windage) are carried out of the tower with the heated air.

Several chemicals are added to the RCW as corrosion inhibitors, fungicides, microbicides and pH adjusters (Table 4.1). In addition, asbestos fibers have been observed in samples of RCW from X-633, and Freon-114 (and lesser amounts of Freon 113) has been entering the RCW from process buildings.

Several potential sources of ground-water contamination are associated with the RCW system. An unknown quantity of RCW was spilled near the X-633-2D Cooling Tower on March 15, 1980 when a hose became disconnected. In addition, sulfuric acid has been reported to have leaked from a storage tank along the southeast wall of X-633-1. A study of the backfill associated with the cooling tower conducted in 1987 suggests that much of the acid may have accumulated in the fill around the structure and that chromium contamination (0.02-8.2 ppm) was present in seven water samples collected from backfill surrounding the RCW line (IEP, 1987). Finally, the basins associated with the cooling towers are known to be cracked. An attempt was made to repair some of the cracks, but the effectiveness of these repairs is unknown.

The loss of RCW through drift is another potential contaminant source which requires investigation. Preliminary studies of soil contamination demonstrate a notable decrease in contaminants within a short distance of the towers. The Quadrant II RFI will focus on the effect of RCW drift on soil chemistry along the hillside downwind from the towers, as well as the effect of leakage and spills (RCW and sulfuric acid) on soil and ground water.

4.6.4.2 Unit Investigation

Anticipated Site Geology

The Minford clay shows a trend of northward thinning, with thicknesses ranging from 22 feet in the south (701-36) to 9 feet in the north (F-5 and F-6BR). The Minford silt also thins to the north; the thickness of the silt unit is generally uneven, but tends to be less than 5 feet near X-633. The Gallia is approximately 6-feet thick near the south end of the X-633 RCW complex (701-36), and thins to the north, where it eventually pinches out. The location of the pinchout is unknown and probably variable, but the Gallia is absent at well 701-44, suggesting that the pinchout occurs in the southern half of the X-633 area. The thinning of the Gallia corresponds to an increasing bedrock elevation, suggesting that much of the area near the X-633 system was a topographic high which partially delineated the edge of the Portsmouth River Valley prior to glaciation. The Sunbury Shale forms the bedrock surface and is present at a thickness of 15 to 30 feet in this area.

Ground-Water Quality and Flow Direction

Water-level measurements in wells near X-633, which were installed during the Ground Water Quality Assessment of X-701B, indicate the presence of a ground-water divide in the Gallia east of the X-633-2C and X-633-2A cooling towers (Figures 4.1 and 4.2). The divide bisects X-633-2B and is located just west of X-633-2D. Localized flow is complicated somewhat by the presence of two water-table mounds near the X-633 RCW system. In general, flow at the two northernmost cooling towers and the X-633-1 pumphouse is to the southwest. Ground-water flow at X-633-2B is predominantly northward, with strong northeast and northwest components, depending on location relative to the divide. Ground water near the X-633-2D cooling tower flows southeast and east. Ground-water

flow in the underlying Berea is to the northeast (Figure 4.3).

During the Ground Water Quality Assessment investigation in 1988, two wells located near the X-633-2D cooling tower were sampled for ground-water contamination in the Gallia. Neither well (701-44 or 701-36) contained detectable concentrations of VOC's or radionuclides.

To further define ground-water quality and flow directions in the area, seven monitoring wells will be installed: one in the Berea and six in the Gallia (Plates I, II and III, Appendix A). These locations were chosen to provide framework definition for this region of Quadrant II as well as site-specific data regarding X-633. A Berea/Gallia well cluster will be installed northeast of X-633 to obtain additional hydrogeologic framework data.

Water samples collected from the monitoring wells will be submitted to a laboratory and analyzed for RCW additives (Table 4.1) and radionuclides. A field-GC analysis will be conducted on water samples from all wells to determine if VOCs are present. If contaminants are detected, additional monitoring wells will be installed, as necessary, to define the extent of the plume.

Soil Sampling

Thirteen soil borings will be drilled around the cooling tower basins, RCW pumphouse and lines (Plates I, II and III, Appendix A) to obtain data concerning the extent of contamination in these areas. Continuous soil samples will be taken from the ground surface to bedrock using standard hollow-stem augering and continuous split-spoon sampling techniques. Field-GC VOC analyses, field radionuclide scans, and field pH determinations will be conducted at intervals of two feet. A soil sample from each 2-foot interval (surface to water table) will be sent to a laboratory for chromium analyses. In addition, every tenth sample will be

sent to a laboratory for VOC analysis to provide a QA/QC check on field-GC results. Selected soil samples will be submitted to a laboratory for analysis for RCW additives. All samples not sent to the laboratory will be stored on site for possible future analysis. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on field-GC and early laboratory results, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional sampling locations may be selected, as necessary, to determine the extent of contamination.

Drift Study

Permanent, continuous emission-monitoring stations have not been installed on the X-633 cooling towers; however cooling-tower drift studies have been performed at PORTS. In 1975, PORTS personnel conducted a study to assess possible contamination resulting from drift originating at the X-633 cooling tower system. During this study, samples of soil and vegetation were taken at intervals downwind from the cooling tower. These samples were analyzed for chromium and zinc which are present in the RCW additive Orocol, a corrosion inhibitor. Ideally, the concentrations of chromium and zinc in the RCW are maintained at 9 ppm and 2 ppm, respectively (Table 4.1). Results of the drift study indicate that extractable chromium concentrations of approximately 4.0 ppm are present in soil samples one meter from tower. Chromium concentrations are less than 0.5 ppm 325 meters away. The findings of the PORTS study will be incorporated into the data collected during the planned assessment.

The drift study will concentrate on the wooded area located northeast of X-633, primarily on the hillside immediately east of the Perimeter Road. A preliminary survey revealed that vegetation

in the area, particularly coniferous trees, appears to be stressed, although it is not known whether X-633 is the cause of the stress. Ten soil samples will be collected to a depth of six inches at selected locations using standard manual soil-auger techniques (Plates I and II, Appendix A). Each sample will be composited and submitted to a laboratory for analysis of chromium and zinc concentrations. Additional samples may be needed to determine the full extent of contamination. To determine background concentration of metals in the soil zone, two soil samples will be collected from the hilly area west of the plant-site (upwind). The regolith on the hilly areas both east and west of PORTS is derived primarily from the Cuyahoga Shale.

4.6.5 X-700 Chemical Cleaning Facility

4.6.5.1 Unit Description

The X-700 Chemical Cleaning Facility has been used since 1955 for cleaning and maintenance of cascade equipment exposed to non-radioactive hazardous substances. The facility is centrally located with respect to the process buildings and is housed in a 200-foot by 520-foot building. The facility is divided into a cleaning area which occupies the eastern half of the building and a converter shop located in the western half of the building.

The cleaning area along the eastern half of the facility is utilized to clean all cascade components not exposed to uranium. This may include degreasing as well as the removal of rust and hard-water deposits. These processes are facilitated by eight cleaning tanks, two vapor degreasers, and a sand-blast cabinet.

The cleaning tanks range in size from 18,000 to 24,000 gallons. Four of the tanks are constructed of concrete and lined with acid-proof brick while the other four are constructed of nickel-plated steel. The tanks are 11-feet deep, and extend 4-feet below ground level. The contents of the tanks are as follows: two 18,000 gallon tanks of sodium bisulfate, two 24,000 gallon tanks and one 18,000 gallon tank of alkali, one 8,000 gallon tank of chromic acid, and two 24,000 gallon tanks of rinse water. Tank outlet drains, tank overflow drains and surrounding floor drains formerly discharged directly into the X-701C Neutralization Pit. Basement floor drains emptied into a clay pipe (vitreous crock) which discharged into a basement sump (Figure 4.4). The sump contents were then discharged to the X-701C pit. All discharges to X-701C were discontinued in 1988 when the pit was deactivated.

Two vapor degreasers, constructed of nickel-plated steel, were also part of the cleaning operation. Vapor Degreaser No. 1 has

been in operation since 1955. Vapor Degreaser No. 2 was used from 1955 until the early 1980's when it was deactivated and removed from the building. TCE was used for degreasing until 1987 and 1,1,1-TCA has been used since. The Vapor Degreaser No. 1 tank, which is still in operation, is 26-feet deep (14 feet below ground level) and is 15 feet x 13 feet in horizontal dimension. The Vapor Degreaser No. 2 tank was 14-feet deep (9 feet below ground level) and 46 feet x 8 feet in horizontal dimension. Parts to be cleaned are lowered by a crane into the degreaser (above the fluid level) and a set of panels are closed, thus shielding the operation. The heated TCE vapor rises, degreasing the suspended part. As a result of the degreasing operation an oil-based sludge accumulates on the bottom of the vapor degreaser tank. In addition, the vapor degreaser loses between 500 and 1,000 gal/mo through evaporation. Venting of the vapor degreaser fumes is accomplished through a plenum, located on the east side of X-700, which discharges to a large stack.

To facilitate the operation of the degreaser the accumulated sludge (a listed RCRA waste) is removed annually. This is accomplished by first vaporizing all remaining solvent in the tank and venting the vapors through the stack on the east side of X-700. The sludge is shoveled into appropriate containers for plant storage. The degreaser tank is then filled with new solvent from the X-700A 1,1,1-TCA Storage Tank located outside the southeast corner of the X-700 building.

The western portion of the X-700 building contains the converter shop. The converter shop provides maintenance on stages of the cascade. Each stage consists of a converter (porous barrier through which UF_6 flows) and a cooler (a primary cooling system). Activities in the converter shop include inspection, welding, pretreatment and testing of converters and coolers. Pretreatment of converters is accomplished in ovens where fluorine gas is circulated through the converter.

Although no releases of hazardous substances from the X-700 Cleaning Facility are documented, the four brick-lined cleaning pits are known to have experienced cracking and mortar degradation and have been repaired in the past. However, the effectiveness of these repairs is not known. In addition, the underground process lines east of the building have never been tested for leakage. Consequently, the integrity of these lines is unknown.

4.6.5.2 Unit Investigation

Anticipated Site Geology

Three wells (701-68, -69 and -70) were installed east of the X-700 building as an Interim Response Action to reported solvent releases from the X-701C Neutralization Pit. Boring logs from these wells indicate that Minford clay and Minford silt exhibit approximate thicknesses of 18 feet and 10 feet, respectively. The Gallia has an approximate thickness of 8 feet in this area. The Sunbury Shale makes up the upper bedrock surface with an approximate thickness of 5 to 10 feet.

Ground-Water Quality and Flow Directions

Water-level measurements from wells surrounding the X-700 facility indicate that ground-water in the Gallia flows to the west under a slight gradient (Figures 4.1 and 4.2). Additional wells will be required to adequately define ground-water flow on the western side of the X-700 building.

To further define ground-water quality and hydrogeologic conditions in the vicinity of X-700, two monitoring wells will be installed west of the building (Plates I and II, Appendix A). These wells, which will be completed in the Gallia, are also discussed in the work plans for X-705 and the process waste lines (see sections 4.6.10 and 4.6.16 of this work plan). Gallia wells

installed during investigations of the X-701C, X-705 and X-720 facilities will provide data concerning ground-water flow and the extent of ground-water and soil contamination in this area. This information is of particular importance because X-700 is located near a ground-water divide which extends across Quadrant II from southwest to northeast (Figure 4.1).

Ground-water samples obtained from the newly installed wells will be analyzed for VOC's using the field-GC. If a plume is located, additional monitoring wells may be installed to refine and focus the monitoring-well pattern in the area of contamination. Once the size and shape of the plume has been defined, ground-water samples from at least three wells located in the part of the plume with the highest contaminant concentrations will be submitted for Appendix IX and radionuclide analyses. If a plume is not indicated based on field-GC analyses, at least three Gallia wells will be selected downgradient from the facility for Appendix IX and radionuclide analyses.

The Appendix IX and radionuclide analyses will provide a list of constituents which will be used as parameters to define the full extent of contaminant migration and to provide horizontal and vertical profiles of these constituents. Additional wells will be installed, as needed, to achieve this objective.

Soil Sampling

Seven soil borings will be drilled along the east side of the X-700 Chemical Cleaning Facility to evaluate the possibility of leakage from the process lines which connect the cleaning tanks and floor drains to the X-701C Neutralization Pit (Plates I and II, Appendix A). These borings will be drilled using standard hollow-stem augering and continuous split-spoon sampling techniques. Soil samples will be obtained during installation of the monitoring wells in the same manner. Field-GC VOC analyses, field

radionuclide scans, and field pH determinations will be conducted on soil samples at two-foot intervals. Every tenth sample will be submitted for laboratory VOC analysis as a QA/QC check on the field-GC results. All remaining soil samples will be stored on site in the event that further analysis is warranted. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on the field-GC analyses, selected soil samples will be submitted to a laboratory for CLP Target Compound List and radionuclide analyses. Additional boreholes may be drilled to define the lateral and vertical extent of any soil contamination.

Waste Sampling

To characterize the fluids that are discharged to the basement sump at X-700, a fluid sample will be collected from the sump and analyzed for Appendix IX and radionuclide parameters. The sample will also be analyzed on-site with a field-GC to detect VOC's.

4.6.6 X-700 TCE/1,1,1-TCA Outside Storage Tank

4.6.6.1 Unit Description

The X-700 TCE/1,1,1-TCA Outside Storage Tank is a 10,000 gallon, above-ground, steel tank located outside the southeast corner of the X-700 Chemical Cleaning Facility. The tank is surrounded by a 3-foot high concrete dike which was constructed in the late 1970's. The tank was used from 1954 to 1987 for storage of TCE for use in the vapor degreasers in the X-700 building. Since 1987, the tank has been used to store 1,1,1-TCA for use in the same vapor degreasers.

Although there have been no documented releases from the tank, there is evidence of spillage around the refill pipe couplings approximately 30 feet south of the tank. From 1954 until construction of the concrete dike, a substantial quantity of solvent may have been spilled or leaked in the area, and may have contributed to soil and ground water contamination.

4.6.6.2 Unit Investigation

Anticipated Site Geology

Boring logs from the wells in the vicinity of the tank (701-45, 701-26 and 701-27) indicate that in this area the thicknesses of the Minford clay and Minford silt vary greatly, ranging from 16 to 33 feet and 0 to 18 feet, respectively. The Gallia in this area is present at an approximate thickness of 2 to 10 feet, and is underlain by the Sunbury Shale at an approximate depth of 38 to 40 feet. In this area, the Sunbury Shale has an approximate thickness of 5 to 10 feet.

Ground-Water Quality and Flow Direction

Based upon water-level measurements from wells in the vicinity of the tank, ground water in the Gallia in this area appears to flow generally to the west under a very gentle gradient (Figure 4.1). Additional wells will be installed during the investigations of X-705 and X-720 to more accurately define the direction and gradient of ground-water flow in the Gallia in this area.

All existing wells near the tank were sampled during November and December of 1988 for VOC and radionuclide analyses. Results of these analyses indicate that 701-45 and 701-27 exhibited TCE contamination of 20 ppb and 8 ppb, respectively. However, based upon calculated ground-water flow directions in the area, 701-27 appears to be located upgradient, and 701-45 appears to be located lateral to the tank with respect to flow direction. Therefore, contamination in these wells may originate from another source.

Soil Sampling

To determine if contamination exists in the area, three soil borings will be drilled in a semi-circle around the eastern side of the tank (Plates I and II, Appendix A). Continuous soil samples will be taken from the ground surface to bedrock using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses and field radionuclide scans will be conducted on soil samples at an interval of two feet. Every tenth sample will be sent to a laboratory for VOC analysis as a QA/QC check on the field-GC results. All samples not sent to the laboratory will be stored on site in the event that future analysis is warranted. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based upon the field-GC results, selected soil samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional boreholes may be drilled to determine the lateral and vertical extent of any contamination.

4.6.7 X-700 Chemical & Petroleum Storage Containment Tanks

4.6.7.1 Unit Description

Two underground chemical and petroleum containment tanks are located near the southeast corner of the X-700 Chemical Cleaning Facility. These concrete tanks have lateral dimensions of 6-feet by 16-feet and are 8-feet deep. Each tank has a capacity of 4800 gallons. The tanks were designed to contain large TCE/1,1,1-TCA spills which could occur during refilling of the X-700 TCE/1,1,1-TCA Outside Storage Tank. The tanks are interconnected at the base by two 8-inch steel pipes. A valve located at the base of one of the containment tanks controls discharge to Storm Sewer E.

4.6.7.2 Unit Investigation

Anticipated Site Geology

Boring logs from the X-700 area indicate that the Minford clay exhibits a thickness of 16 to 33 feet and the Minford silt a thickness of 0 to 18 feet. The Gallia has an approximate thickness of 2 to 10 feet in this area. The bedrock surface is formed by the Sunbury Shale which is 5 to 10 feet thick in this area.

Ground-Water Quality and Flow Direction

Based upon water-level measurements from wells in the vicinity of the containment tanks, ground water in the Gallia flows west under a very gentle gradient (Figure 4.1). Additional wells will be installed during the investigations of X-705 and X-720 to more accurately define the direction and gradient of ground-water flow in the Gallia near X-700.

All existing wells near X-700 were sampled during November and December of 1988 for VOC and radionuclide analyses. Results of

these analyses indicate that 701-45 and 701-27 exhibited TCE contamination of 20 ppb and 8 ppb, respectively. However, based upon calculated ground-water flow directions in the area, 701-27 appears to be located upgradient, and 701-45 appears to be located lateral to the tanks with respect to flow direction. Therefore, contamination in these wells may originate from another source.

Waste Sampling

Two fluid samples will be collected from each storage containment tank to provide a preliminary assessment of potential contaminants which may exist in the containment tanks. One sample will be collected from the top and one sample from the base of the fluid column in each tank, thus providing an accurate determination of fluid composition in the event that stratification of chemicals has occurred. Field-GC analysis of all samples will be performed on-site to determine if VOC's are present. In addition, all samples will be submitted for Target Compound List and radionuclide analyses.

Soil Sampling

To determine if they are leaking, two soil borings will be installed immediately adjacent to the tanks. The borings will be located at the northeast and southwest corners of the tanks (Plates I and II, Appendix A). The borings will be drilled to bedrock using standard hollow-stem augering and continuous split-spoon sampling techniques. Field-GC VOC analyses and field radionuclide scans will be conducted on soils at an interval of two feet. Every tenth sample will be sent to a laboratory for VOC analysis as a QA/QC check on the field-GC results. Samples which are not submitted to a laboratory will be stored on site in the event that further analysis is warranted. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on the results of field-GC analyses, selected soil samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional boreholes may be drilled to define the lateral and vertical extent of any soil contamination.

4.6.8 X-701 Northeast Biodegradation Plot

4.6.8.1 Unit Description

The Northeast Biodegradation Plot was operated from August 1973 through September 1974. The site consists of two 400-foot by 20-foot plots which were used for the disposal of 1,800 gallons of solvents and radionuclide-contaminated waste oils and 6,000 pounds of oil-soaked fuller's earth. PCB- and uranium-contaminated sewage sludge from the X-615 Sewage Treatment Plant were also disposed of at this unit. In general, these wastes were spread evenly over the plots and then disked or tilled on a monthly basis throughout the spreading season (August to October). After waste degradation, the pH was adjusted and nitrogen fertilizer was added. Use of the X-701 Northeast Biodegradation Plot was discontinued due to improper drainage which resulted in transport of material into the East Drainage Ditch.

4.6.8.2 Unit Investigation

Anticipated Site Geology

The total thickness of unconsolidated sediments ranges from 30 to 35 feet in the area near the Northeast Biodegradation Plot. The Minford clay is about 9 feet thick in this area. The Minford silt is generally about 15 feet thick, but is highly variable, ranging in thickness from 3 to 18 feet. The Gallia is 1 to 3 feet thick near the oil plot, thins to the north, and becomes notably uneven in thickness to the east. The Sunbury Shale makes up the underlying bedrock surface, and is approximately 15 feet thick in this area.

Ground-Water Quality and Flow Directions

In the vicinity of the Northeast Biodegradation Plot, flow in the Gallia is to the south-southeast (Figure 4.2). East of the oil plot, ground water flows gradually more eastward, and flows nearly due east near the Perimeter Road.

A ground-water divide is located immediately west of the oil plot (Figure 4.2). Flow on the west side of the divide is to the southwest. It is possible that contaminants originating at the oil plot may be present on both sides of the divide.

The potentiometric surface of the Berea is marked by an anomalous high immediately west of, and partially underlying, the Northeast Biodegradation Plot (Figure 4.3). As a result, flow in the Berea is locally toward the northeast and southeast, although an eastward component is prevalent in the vicinity of the oil plot. Approximately 15 feet of Sunbury Shale separates the Gallia and Berea near the oil plot. The Sunbury is a very competent confining layer, as is evident by the large head difference between the Berea and Gallia.

Monitoring wells were installed near the oil plot as part of the Ground Water Quality Assessment for the X-701B Holding Pond. Water samples from these wells (701-11, 701-38, 701-39, and 701-63) revealed no detectable quantities of VOC's or Radionuclides near the oil plot.

Soil Survey

Six soil borings will be drilled within the former boundaries of the Northeast Biodegradation Plot (Plates I and II, Appendix A). Continuous soil samples will be taken from the ground surface to bedrock using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses and field radionuclide

scans will be conducted at intervals of two feet. Every tenth sample will be sent to a laboratory for VOC analysis to provide a QA/QC check on field-GC results. Remaining samples will be stored on site for possible future analysis. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA standards.

Based on field-GC results, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional sampling locations may be selected to determine the extent of any soil contamination in the vicinity of the biodegradation plot. In addition, six soil samples will be collected from the sides of the East Drainage Ditch to determine if runoff from X-701B is contaminated and to assess the extent of soil contamination.

4.6.9 X-701C Neutralization Pit

4.6.9.1 Unit Description

The X-701C facility consists of a neutralization pit and a pump pit. The neutralization pit has horizontal dimensions of 25 feet x 25 feet and is 18-feet deep (Figure 4.5). The floor and walls are constructed of concrete and lined with acid-proof brick. A sump in the bottom of the neutralization pit discharges into the adjacent pump pit. The pump pit, which is constructed of concrete, is 9-feet deep and covers approximately 81 square feet. Two lines enter the X-701C pit, an 8-inch line from X-700 (process fluids) and a 4-inch line from the lime house. An agitator at the bottom of the pit ensures even mixing of the lime and process fluids.

The X-701C Neutralization Pit received process effluents from the X-700 Chemical Cleaning Facility until November 1988. The Chemical Cleaning Facility includes eight cleaning tanks (ranging in size from 18,000 to 24,000 gallons) which contain sodium acid sulfate, sodium hydroxide, chromic acid cleaning solutions and rinse water. Tank outlet drains and tank overflow drains discharged directly to X-701C. Two vapor degreasers were also used in the cleaning operation. Vapor Degreaser No. 1 has been in operation since 1955. Vapor Degreaser No. 2 was used from 1955 until the early 1980's when it was deactivated and removed from the building. TCE was used for degreasing until 1987 and 1,1,1-TCA has been used since.

Prior to February 1982, effluent from X-701C was discharged to the X-701B Holding Pond once a week. Spent acid, alkali solutions, and rinse water from X-700 were discharged to the neutralization pit on a batch basis. After the pH was adjusted the contents of the pit were released to the X-701B pond (approximately 50,000 gallons per week). From February 1982 to May 1987 the X-

701C pit effluent was diverted to the X-616 Treatment Facility via the RCW blowdown line. The purpose of this procedure was to reduce the high concentration of suspended solids discharging from X-701B through NPDES 001. In May 1987 chlorinated organics were discovered in the X-700 Building basement sump, which discharged to X-701C. During 1987 and 1988 discharge of pit effluent to X-616 was discontinued. The effluent was rerouted back to the X-701B Holding Pond until November 1988, when the operation of X-701B was discontinued. Currently, all floor drains, tank-outlet drains and the basement sump in the X-700 cleaning area discharge to a carbon-filtration system located inside the northern end of the facility. When the holding capacity of the system is reached the effluent is either re-introduced into the cleaning operation, or is transported by tanker truck and discharged into one of the X-633 cooling tower basins.

4.6.9.2 Unit Investigation

Anticipated Site Geology

Three Gallia wells (701-68, -69 and -70) were installed east of the X-700 building as an Interim Response Action to reported solvent releases from the X-701C Neutralization Pit. Boring logs from these wells indicate that the Minford clay and the Minford silt exhibit approximate thicknesses of 18 feet and 10 feet, respectively. The Gallia has an approximate thickness of 8 feet in this area. The Sunbury Shale makes up the upper bedrock surface with an approximate thickness of 10 feet.

Ground-Water Quality and Flow Directions

Water-level measurements from wells surrounding the X-700 facility indicate that ground water in the Gallia flows to the west under a slight gradient (Figures 4.1 and 4.2).

Field-GC analyses for VOC's were performed on soil samples collected at two-foot intervals during drilling of 701-68, 701-69, and 701-70. TCE was detected in all three soil borings around the X-701C pit. In all three cases, contamination was present in the Gallia. Measurable concentrations of TCE were detected in soil samples taken from depths of 16 to 32 feet in 701-69; the maximum concentration of 3378 ppb occurred at a depth of 22 feet. In 701-68, TCE was detected from 12 to 28 feet, with a maximum concentration of 2057 ppb measured at 16 feet below ground surface. VOC's were found in 701-70 from 14 to 36 feet below the surface, with a maximum of 204 ppb occurring at 16 feet.

To further define ground-water quality and hydrogeologic conditions in the vicinity of X-701C, two monitoring wells will be installed west of the X-700 Chemical Cleaning Facility (Plates I and II, Appendix A). Details of sampling and analysis for these wells, which will be completed in the Gallia, are discussed in the work plans for X-705 and the process waste lines (see Sections 4.6.10 and 4.6.16). Gallia wells installed during investigations of the X-705 and X-720 facilities will provide data concerning ground-water flow and the extent of ground-water and soil contamination in this area. This information is of particular importance because X-701C is located near a ground-water divide which extends across Quadrant II from southwest to northeast (Figure 4.1). Additional wells will be installed as required, to define the extent of ground-water contamination in this area.

Soil Sampling

Two additional soil borings will be drilled to further define the extent of contamination in this area (Plates I and II, Appendix A). One of these borings will be located between Jackson Avenue and X-744J due east of X-701C. The second soil boring will be drilled in the open field between the pit and the TCE/1,1,1-TCA tank. Continuous soil samples will be taken from the ground

surface to bedrock using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses and field radionuclide scans will be conducted at intervals of two feet. Every tenth sample will be sent to a laboratory for VOC analysis to provide a QA/QC check on field-GC results. All samples not sent to the laboratory will be stored for possible future analysis. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on field-GC results, selected soil samples will be submitted for CLP Target Compound List and radionuclide analyses. If contamination is detected, selected boreholes may be completed as monitoring wells. The wells will be sampled and analyzed for those constituents identified in prior analyses. Additional wells and/or boreholes may be installed, as required, to define the extent of contamination.

4.6.10 X-705 Decontamination Building

4.6.10.1 Unit Description

The X-705 Decontamination Building has been used since 1955 for the decontamination of equipment exposed to uranium compounds and the recovery of uranium from decontamination solutions. The facility is housed in a 520-foot by 169-foot building which is centrally located with respect to the process buildings.

The method of decontamination used at X-705 is dependent upon the size of the equipment. Large equipment such as converters and compressors are disassembled and vacuumed to remove uranium compounds. The parts are then placed on a dolly and further decontaminated in a series of connected spray booths which use recirculating nitric acid, ammonium carbonate and rinse water. These solutions are then processed at a solution recovery facility. Prior to November 1988, the final rinse water from this process was discharged to the X-701B Holding Pond. After November 1988, the final rinse booth was converted to a recirculating system.

Small parts are decontaminated at X-705 by hand, using water, nitric acid and ammonium carbonate. All parts are then steam cleaned as part of the final decontamination process. Prior to November 1988, all effluent from these processes was discharged to the X-701B Holding Pond.

All uranium recovery activities at PORTS are performed at the X-705 Decontamination Building. Feed solutions are digested with nitric acid. This solution is concentrated and then extracted and calcinated to produce uranium oxide. The uranium oxide is converted to uranium hexafluoride and reintroduced into the cascade.

High concentrations of ammonia in Little Beaver Creek and the East Drainage Ditch have been traced to the use of ammonium carbonate at X-705. Uranium contamination of soils outside the northwest corner of X-705 has been attributed to routine sandblasting on the west storage pad and losses of uranium-contaminated solutions from polyethylene bottles which were stored on the pad and inadvertently allowed to freeze and rupture. Contaminated gravel from this area was transported to the X-749 landfill for storage and contaminated soil was moved to an area north of the West Retention Basin at X-701B. No documentation of adequate cleanup of this area is available.

4.6.10.2 Unit Investigation

Anticipated Site Geology

Relative to other sites at PORTS, the geology in the area near the X-705 building is not well defined. According to boring logs from two wells in the general vicinity (701-29 and 701-45), the thicknesses of the Minford silt and clay are highly variable, ranging from 0 to 20 feet and 8 to 32 feet, respectively. The Gallia in this area ranges in thickness from 2 to 10 feet. The Sunbury Shale makes up the upper bedrock surface, underlying the Gallia at depths of 34 to 38 feet below ground surface. In this area, the Sunbury Shale has a thickness of 5 to 10 feet.

Ground-Water Quality and Flow Directions

Water-level measurements from wells installed during the Ground Water Quality Assessment of X-701B indicate that in this area of Quadrant II, ground water in the Gallia flows to the west under a gentle gradient (Figure 4.1). However, no data concerning ground-water flow or quality in the immediate vicinity of X-705 is currently available. Additional monitoring well installation and

sampling will therefore be required to sufficiently define these parameters.

To adequately characterize the hydrogeology of the area, eight monitoring wells will be installed: seven Gallia wells and one Berea well (Plates I and II, Appendix A). Two of the Gallia wells will be located east of X-705 to monitor the upgradient side of the building. These wells will also serve to monitor the downgradient side of the X-700 building, which is adjacent to X-705. Two other Gallia wells will be installed west of X-705 to monitor the downgradient side of the building. Gallia wells installed during the investigation of X-720 will provide additional data concerning ground-water flow and the extent of ground-water and soil contamination in this area.

Ground-water samples obtained from the newly installed wells will be analyzed for VOC's using the field-GC. If a plume is located, additional monitoring wells may be installed to refine and focus the monitoring-well pattern in the area of contamination. Once the size and shape of the plume has been defined, ground-water samples from at least three wells located in the part of the plume with the highest contaminant concentrations will be submitted for Appendix IX and radionuclide analyses. If a plume is not indicated based on field-GC analyses, at least three Gallia wells will be selected downgradient from the facility for Appendix IX and radionuclide analyses.

The Appendix IX and radionuclide analyses will provide a list of constituents which will be used as parameters to define the full extent of contaminant migration and to provide horizontal and vertical profiles of these constituents. Additional wells will be installed, as needed, to achieve this objective.

Soil Sampling

During the drilling of the monitoring wells, the soils in each borehole will be sampled continuously. Field-GC VOC analyses and field pH determinations will be conducted on soil samples at an interval of two feet. Every tenth sample will be submitted for laboratory VOC analysis as a QA/QC check on the field-GC results. The remaining samples will be stored on site in the event that further analysis is warranted. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA standards.

Based on the field-GC analyses, selected samples will be submitted to a laboratory for CLP Target Compound List and radionuclide analyses. Additional boreholes may be drilled to determine the lateral and vertical extent of any soil contamination in the vicinity of the X-705 facility.

Waste Sampling

To characterize the fluid that is discharged to the basement sumps at X-705, a fluid sample will be collected from each sump and submitted for analysis of Appendix IX and radionuclide parameters. The samples will also be analyzed on-site with a field-GC to detect VOC's.

4.6.11 X-705A Radioactive Waste Incinerator and X-705B Contaminated Burnable Storage Lot

4.6.11.1 Unit Description

The X-705A incinerator site covers approximately 4,000 square feet and includes the X-705A incinerator and the adjacent storage lot. The incinerator is a dual-chambered unit designed to burn a variety of combustible material including paper, wood, rubber, and plastic. The incinerator was operational from 1955 to 1986, at which time the EPA was notified that approximately 370 gallons of flammable liquids (waste oil and tributyl phosphate) were mixed with the burnable solids prior to incineration. Laboratory analyses indicated that some of the waste oil batches failed the EP toxicity test for mercury, and some ash samples exceeded the allowable concentrations for barium and cadmium. As a result, X-705A was listed as a hazardous waste incinerator, and ceased operation.

The X-705B storage lot is a 25-foot by 25-foot concrete pad which provides temporary storage for burnable material prior to incineration. Burnable wastes are stored on the lot in 55-gallon drums, many of which are uncovered. Holes are punched near the bottoms of the drums to prevent accumulation of rain water in the drums which could result in an unsafe nuclear geometry.

Ash taken from the incinerator was placed in five-inch cylinders. An auger sample was taken from each cylinder and analyzed for uranium content. If the results showed a uranium concentration which is economically recoverable, the uranium was leached from the ash with acid. Cylinders of ash which were not subjected to uranium recovery were placed in wooden boxes and buried at the X-749 South Contaminated Materials Storage Facility.

Effluent from X-705A was primarily hot vent gas consisting of CO₂ and water vapor with traces of uranium particulate. Uranium particulate emissions of 6 to 15 micrograms per hour were documented during test sampling of the incinerator. Runoff from the incinerator pad may include contaminated ash. In 1987, laboratory analyses of soil samples collected near X-705A revealed one sample containing 0.65 ppb of polychlorinated dibenzodioxins. X-705A is listed in USEPA and OEPA Consent Orders as requiring investigation.

4.6.11.2 Unit Investigation

Anticipated Site Geology

Well borings for 701-29 and 701-45 indicate the Minford clay has a thickness of approximately 0 to 30 feet in this area. The Minford silt is considerably uneven in thickness east of X-705, where it is absent at 701-29 and 20-feet thick at 701-45. The Gallia is roughly 4-feet thick in this area. The Sunbury Shale makes up the upper bedrock surface in the vicinity of X-705 with an estimated thickness of 5 to 10 feet.

Ground-Water Quality and Flow Directions

Water-level measurements from monitoring wells installed during the Ground Water Quality Assessment for X-701B indicate that ground-water flow in the Gallia is to the west near X-705 (Figures 4.1 and 4.2). The potentiometric surface for the Berea slopes gently to the northeast at this location (Figure 4.3).

Both 701-29 and 701-45 were sampled in November and December 1988 for analysis of VOC's and radionuclides. Ground-water samples from 701-29 exhibited no detectable contamination; 701-45 exhibited a TCE concentration of 20 ppb.

Soil Sampling

The primary avenues for contamination at the X-705 incinerator facility are air and surface-water runoff. Therefore, the investigation of the incinerator and adjacent storage lot will emphasize soil contamination. Eight soil samples will be acquired from locations around the incinerator and storage lot using standard manual soil-auger techniques (Plates I and II, Appendix A). The soil samples may be composited to a depth of 2-feet below ground surface, and submitted for analysis of radionuclides. Additional samples will be collected, as needed, to define the extent of soil contamination in this area.

4.6.12 X-720 Maintenance and Stores Building

4.6.12.1 Unit Description

The X-720 Maintenance Building has been used from 1954 to the present for maintenance, testing and inspection of process and auxiliary equipment. The building is a 370-foot by 760-foot structure, centrally located with respect to the process buildings (Plate I, Appendix A). The facility is partitioned into individual shops for carpentry, utility and process maintenance, welding, electrical repair, valve and instrument maintenance and machine work. A neutralization pit used for waste treatment and disposal is located at the northeast corner of the facility.

Though no releases of hazardous waste from the X-720 building have been documented, several hazardous substances are known to have been present there. These include radionuclide waste from equipment maintenance at X-720, and pump oil and cleaning solvent TCE from the valve shop. In addition, cleaning and plating solutions (hydrochloric acid, nitric acid, sulfuric acid and cyanide salts) from the instrument shop and acids, acetone, kerosene and 1,1,1-TCA (formerly TCE) were all used and then discharged to the neutralization pit. Following treatment in the neutralization pit, the wastes discharged to the sanitary sewer system.

4.6.12.2 Unit Investigation

Anticipated Site Geology

Four monitoring wells have already been installed in the vicinity of X-720: 701-45, 701-46, F-15 and F-16BR (Plate I, Appendix A). Boring logs from the wells closest to the facility (701-45 and F-15) indicate that in this area the Minford clay and Minford silt range in thickness from 8 to 30 feet and 0 to 20 feet,

respectively. The Gallia in this area exhibits an approximate thickness of 10 feet, and is underlain by the Sunbury Shale at an approximate depth of 38 to 40 feet. In this area, the Sunbury Shale has an thickness of 5 to 10 feet.

Ground-Water Quality and Flow Direction

Based upon water level measurements from wells in the vicinity of X-720, ground water in the Gallia in this area appears to flow toward the west under a gentle gradient (Figure 4.1). Additional wells will be required to more fully define the direction and gradient of ground-water flow in the Gallia in this area.

All existing wells near X-720 were sampled during November and December of 1988 for VOC and radionuclide analyses. Results of these analyses indicate that only 701-45 exhibited contamination; the TCE concentration in ground water from 701-45 was 20 ppb. However, based upon current ground-water flow directions in the area, 701-45 appears to be located lateral to X-720 with respect to the flow direction. Consequently, contamination in this well may originate from a source east of the maintenance building.

To further define ground-water quality and flow directions in the area, six monitoring wells will be installed: five in the Gallia and one in the Berea (Plates I and II, Appendix A). The locations of four of the Gallia wells were chosen to complete a network of perimeter monitoring wells around X-720. The location of the Gallia/Berea well cluster, just east of Pike Avenue, was selected to obtain hydrogeologic framework data concerning this area of Quadrant II. Gallia wells installed during the investigation of X-705 will provide additional data concerning ground-water flow and the extent of ground-water and soil contamination in this area.

Ground water samples obtained from the newly installed wells will be analyzed for VOC's using the field GC. If a plume is located, additional monitoring wells may be installed to refine and focus the monitoring-well pattern in the area of contamination. Once the size and shape of the plume has been defined, ground-water samples from at least three wells located in the part of the plume with the highest contaminant concentrations will be submitted for Appendix IX and radionuclide analyses. If a plume is not indicated based on field-GC analyses, at least three Gallia wells will be selected downgradient from the facility for Appendix IX and radionuclides analysis.

The Appendix IX and radionuclide analyses will provide a list of constituents which will be used as parameters to define the full extent of contaminant migration and to provide horizontal and vertical profiles of these constituents. Additional wells may be installed, as needed, to achieve this objective.

Soil Sampling

During the drilling of the monitoring wells, soils in each borehole will be sampled continuously using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses, field radionuclide scans, and field pH determinations will be conducted on soil samples at two-foot intervals. Every tenth sample will be submitted for laboratory VOC analysis as a QA/QC check on the field-GC results. Remaining samples will be stored on site in the event that further analysis is warranted. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on the field-GC analyses, selected samples will be submitted to a laboratory for CLP Target Compound List and radionuclide analyses. Additional boreholes may be drilled to define the lateral and vertical extent of any soil contamination.

Waste Sampling

Two fluid samples will be collected from the X-720 pit, one at the bottom and one at the top of the fluid column. Field-GC analyses will be performed on both samples collected from the pit. In addition, the samples will be submitted for Target Compound List and radionuclide analyses.

4.6.13 X-744G Bulk Storage Building

4.6.13.1 Unit Description

The X-744G Bulk Storage Building is an 88,000 square foot warehouse which is used primarily for storage of UF_6 (stored in 5-, 8-, and 12-inch cylinders) and for storage of non-fluorinated materials such as U_3O_8 , UO_3 , UNH, uranium solutions, and radioactive waste materials. These include contaminated solutions, contaminated air emissions control material (aluminum and sodium fluoride), contaminated solid scrap (metals and ash from the X-705A incinerator, and oil absorbent from process buildings which may contain PCBs), and uranium oxides and nitrates (from the X-705 decontamination processes).

As part of an investigation of vadose-zone contamination around the X-701B Holding Pond, four soil borings were drilled along the north side of X-744G during August of 1989. Soil samples were collected from the borings from the surface to bedrock at a 2-foot interval. Field-GC analyses of the samples indicate that some TCE contamination (20-50 ppb) of the vadose zone exists in the area. TCE concentrations in ground water north of the building ranged from 4 to 35 ppb.

4.6.13.2 Unit Investigation

Anticipated Site Geology

The geology and hydrogeology of this area are well defined as a result of the Ground Water Quality Assessment of the X-701B Water Treatment Facility. The Minford is roughly 26 feet thick near X-744G, but varies in thickness from 22 to 33 feet. The Minford silt is highly variable in this area, ranging from 0 to 22 feet in thickness (701-30 and 701-34). Other wells in the area suggest the silt layer is generally about 5-feet thick near the Bulk Storage

Building. Near the Bulk Storage Building, the Gallia is 3 to 8 feet thick, with an average thickness of about 5 feet. The variable thickness is due primarily to a local thickening of the Gallia near the northeast corner of the building (701-10 and 701-50). The Sunbury Shale makes up the uppermost bedrock surface in this area at a thickness of approximately 15 feet.

Ground-Water Quality and Flow Direction

Ground-water flow in the vicinity of X-744G is well defined. In this area, ground water flows south-southeast from the area of the X-701B Holding Pond. East of X-744G, ground-water flow is nearly due east (Figure 4.2).

All wells in the vicinity of X-744G were sampled during November and December of 1988 for VOC and radionuclide analyses. The results of these analyses indicate that wells in the area exhibit TCE contamination ranging from 2 to 110,000 ppb. However, this contamination has been attributed to the contaminant plume emanating from the X-701B Holding Pond. The results of the field-GC analyses of soil samples from the north side of the building support this conclusion. Further investigation is required to determine whether there is any soil or ground-water contamination on the south side of the X-744G area.

Soil Sampling

Four soil borings will be drilled along the south side of the Bulk Storage Building (Plates I and II, Appendix A) to obtain data concerning the extent of contamination in this area. Continuous soil samples will be taken from the ground surface to bedrock using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses, field radionuclide scans, and field pH measurements will be conducted at intervals of two feet. Every tenth sample will be sent to a laboratory for VOC analysis to

provide a QA/QC check on field GC results. Remaining samples will be stored for possible future analysis. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on field-GC results, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional sampling locations may be selected to determine the extent of contamination.

4.6.14 X-744 Retrievable Waste Storage Area

4.6.14.1 Unit Description

The X-744 Retrievable Waste Storage Area is an open storage facility covering approximately 83,000 square feet. Large containment vessels at this site are used to store radioactive contaminated items such as shoe covers, rags, paper, cardboard and other small items. Presently, there are two types of storage vessels at the site. Older cylindrical containment vessels (approximately 8 feet in diameter) are constructed of steel and are fully enclosed. Newer steel containment vessels are rectangular and have drain holes near the base to prevent accumulation of rainwater in the container.

4.6.14.2 Unit Investigation

Anticipated Site Geology

The geology and hydrogeology of this area are well defined as a result of the Ground Water Quality Assessment of the X-701B Holding Pond. The Minford is roughly 26-feet thick near X-744, but varies in thickness from 22 to 33 feet. The Minford silt is highly variable in this area, ranging from 0 to 22 feet thick (701-30 and 701-24). Other wells in the area suggest that the silt layer is generally about 5-feet thick near the waste storage area. The Gallia in this area is 3 to 8 feet thick, with an average thickness of about 5 feet. The variable thickness is due primarily to an apparent local thickening of the Gallia near the northeast corner of the building (701-10 and 701-50). The Sunbury Shale makes up the uppermost bedrock surface in this area at an estimated thickness of 15 feet.

Ground-Water Quality and Flow Direction

Ground-water flow in the vicinity of the X-744 Storage Area is well defined. In this area, ground water flows south-southeast from the area of the X-701B Holding Pond. Northeast of the storage area, ground-water flow is nearly due east (Figure 4.2).

All wells near X-744 were sampled during November and December of 1988 for VOC and radionuclide analyses. The results of these analyses indicate that wells in the area exhibit TCE contamination ranging from 2 to 110,000 ppb. However, this contamination has been attributed to the contaminant plume emanating from the X-701B Holding Pond. The results of the field-GC analyses of soil samples from the north side of the X-744G building support this conclusion. Further investigation is required to determine whether there is any radionuclide contamination of soils within the X-744 Waste Storage Area.

Soil Sampling

To address the possibility of soil contamination in the area, ten soil samples will be acquired using standard manual soil-auger techniques (Plates I and II, Appendix A). Soil samples will be composited to a depth of 2 feet below ground surface, and submitted for radionuclide analysis. Field radionuclide scans will be performed on each sample. The sample locations were chosen to provide data concerning the presence of radionuclide contamination of soil throughout the X-744 area. Additional sample locations may be added, as required, to define the extent of any contamination found in the area.

4.6.15 East Drainage Ditch and Little Beaver Creek

4.6.15.1 Unit Description

The East Drainage Ditch receives effluent from the X-701B Holding Pond and the D and E Storm Sewers and from overland flow during rainfall events. From August 1973 to September 1974 the ditch also received runoff from the X-701B Biodegradation Plot. The East Drainage Ditch discharges to Little Beaver Creek east of the Perimeter Road. Little Beaver Creek flows north, then west, eventually leaving DOE property and discharging to Big Beaver Creek. Big Beaver Creek discharges to the Scioto River approximately 2 miles west of the plant site.

Potential contaminants associated with the East Drainage Ditch and Little Beaver Creek include caustic soda, nitric acid, sulfuric acid, uranium, sodium bifluoride, pyranol and various organic compounds.

4.6.15.2 Unit Investigation

Anticipated Site Geology

The thickness of geologic units in the vicinity of the East Drainage Ditch and Little Beaver Creek is notably uneven. Individual units exhibit variations in thickness of more than 10 feet within individual well clusters. The variations in the thickness of the Minford are due in part to the irregular topography of the eastern portion of the plant site. Consequently, the Minford may reach considerable thicknesses but is often absent near the East Drainage Ditch and Little Beaver Creek where erosion has exposed the underlying bedrock. The Minford clay exhibits thicknesses ranging from 0-10 feet in this area. The Minford silt ranges from 0 to 19 feet thick, and exhibits a general trend of thinning to the east. The Gallia occurs at depths of roughly 25

to 30 feet. The Sunbury Shale makes up the uppermost bedrock surface in the area, with an approximate thickness of 15 feet.

Ground-Water Quality and Flow Directions

Ground water in the Gallia and Berea flows to the east in the vicinity of the East Drainage Ditch (Figures 4.2 and 4.3). To further define horizontal and vertical flow directions near Little Beaver Creek, five piezometers will be installed at locations approximately 400 feet apart on either side of the creek bed (Plates I and II, Appendix A). These piezometers, used in conjunction with the monitoring wells installed during the ground-water quality assessment of X-701B, will provide quantitative data regarding the influence of Little Beaver Creek on ground-water flow. In addition, water samples obtained from these piezometers will be analyzed with the field GC to pinpoint the area(s) of Little Beaver Creek which is/are receiving contaminants via ground-water discharge.

Several monitoring wells in the vicinity of the East Drainage Ditch and Little Beaver Creek were sampled during October-December 1988 as part of the X-701B Ground Water Quality Assessment. Ground-water samples were analyzed for VOC's and radionuclides. Contamination is primarily limited to the south side of the East Drainage Ditch; however, 59 ppb TCE was detected north of the ditch near X-230J7 (701-16). TCE concentrations in excess of 10,000 ppb are common on the south side of the East Drainage Ditch. No contaminants have been detected east of Little Beaver Creek.

Soil/Sediment Sampling

Six soil samples will be collected from the sides of the East Drainage Ditch at regularly spaced intervals from its west end to the East Holding Pond (Plates I and II, Appendix A). The samples will be collected to a depth of two feet using standard manual

soil-auger techniques. The total thickness of each soil sample will be composited and analyzed with a field GC to detect the presence of any VOC's. Selected samples will be submitted to a laboratory for the CLP Target Compound List and radionuclide analyses.

In addition to soil samples taken along the margins of the drainage ditch, sediments in the bottom of the ditch will be sampled at six locations (Plates I and II, Appendix A). Each sample will be composited from the total thickness of sediment and analyzed in the same manner as the soil samples.

Sediments in Little Beaver Creek will be sampled at 1,000-foot intervals (eight locations) from the discharge of the X-230J7 East Holding Pond to the X-230J9 sampling station (Plates I and II, Appendix A). Samples will be collected at a 2000-foot interval from X-230J9 to the northwest property boundary (two locations). An additional sample will be collected approximately 1000 feet upstream from the outfall from X-230J7. This sample will be used to determine the background levels of chemical compounds. Samples will be acquired and analyzed in the same manner as the East Drainage Ditch soil samples.

All soil and sediment samples which are not submitted to a laboratory will be stored on site in case further analysis is required. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Surface Water

Eleven surface-water samples will be collected from Little Beaver Creek for laboratory analysis (Plates I and II, Appendix A). Water sample locations will correspond to the locations of sediment samples to allow comparison of laboratory analyses for water/

sediment pairs. In this way recognizable trends in the concentration of contaminants can be used to isolate potential source areas along the creek bed. Selected water samples will be submitted to a laboratory for Appendix IX and radionuclide analyses, along with Federal Primary and Secondary Drinking Water Quality Standards and Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD).

4.6.16 Process Waste Lines from X-700 and X-705

4.6.16.1 Unit Description

Four types of process lines formerly drained the X-700 and X-705 buildings: vitreous crock (clay), stainless steel, CPVC and "Duriron" (cast metallic) (Figure 4.6). The "Duriron", clay and stainless steel lines were used for 33 years. During that time, these lines transported process effluents from X-700 (via X-701C) and from X-705 to the X-701B Holding Pond until the pond was deactivated in November 1988. In 1982 the CPVC pipeline was constructed to reroute the process effluents to the X-616 Effluent Treatment Facility via the RCW Blowdown line. At present, only treated X-705 process effluent enters the CPVC line.

Process chemicals that were discharged from the X-700 Building to X-701C included sodium hydroxide, sodium dichromate, sodium acid sulfate, nitric acid, and sulfuric acid. From 1955 to 1982 and from 1987 to November 1988 approximately 50,000 gallons of treated X-700 process effluent was discharged from X-701C to X-701B every week. During the period from 1982 to 1987 the effluent was rerouted to X-616.

Prior to 1984 approximately 750 gallons/month of raffinate solution was drained from the X-705 solution recovery process and discharged to X-701B. The raffinate solution generally contained less than 15 ppm of uranium and was acidic, with a nitric acid normality of 2 or 3 N. Currently, process effluent is diverted to an array of overhead pipes for temporary storage within the X-705 building. The stored effluent is pH adjusted, then circulated through a microfiltration system. Once the treatment cycle is completed the processed solution is diverted to the X-616 Effluent Treatment Facility.

4.6.16.2 Unit Investigation

Anticipated Site Geology

Well logs from 701-02, -03, -04, -06, -28, and -29 show the Minford clay has a thickness of 0 to 32 feet in this area. The Minford silt ranges in thickness from 0 to 10 feet. The Gallia has an approximate average thickness of 2 feet, although it is absent at numerous locations. The Sunbury Shale which forms the bedrock surface in this area, with an approximate thickness ranging from 5 feet in the west to 15 feet in the east.

Ground-Water Flow Directions

A ground-water divide in the Gallia bisects the process waste lines in the vicinity of X-744J (Figures 4.1 and 4.2). As a result, ground-water flow at the east end of the process lines (near X-701B) is to the southeast, while flow on the west end is to the west. Ground water in the Berea flows northeast (Figure 4.3).

Soil Sampling

To identify potential contamination due to leakage from the process lines, four soil borings will be drilled near the sand and gravel backfill which surrounds the piping (Plates I and II, Appendix B). One boring will be located near the intersection of Defiance Avenue and 18th Street. Two borings will be located along the process line from X-705, and one boring will be drilled near the X-700 process line just north of the X-701C Neutralization Pit.

Continuous soil samples will be collected from the ground surface to bedrock using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses, field

radionuclide scans, and field pH determinations will be conducted at two-foot intervals. Every tenth sample will be submitted for laboratory VOC analysis as a QA/QC check on the field-GC results. All remaining soil samples will be stored on site in the event that further analysis is required. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on the field-GC analyses, selected soil samples will be submitted to a laboratory for CLP Target Compound List and radionuclide analyses. Additional boreholes may be drilled to define the lateral and vertical extent of any soil contamination detected in the vicinity of the process lines.

In addition to soil sampling, a backhoe will be utilized to dig two pits along the process lines. One pit will be located where the line from X-700 begins to parallel the lines from X-705. A second pit will be located just west of where the lines discharge into X-701B (Plates I and II, Appendix A).

150 x 100
40 x 40

The backhoe pits will allow for visual inspection of the process lines, and for sampling of backfill adjacent to the piping. Samples will be collected at selected locations in the pit using standard manual soil-auger techniques. The soil samples will be composited and selected samples submitted to a laboratory for CLP Target Compound List and radionuclide analyses. In addition, field-GC, head-space analyses will be conducted to determine if any VOC's are present.

Two monitoring wells will be installed between X-700 and X-705 during the Quadrant II investigation of these buildings (Plates I and II, Appendix IX) (see sections 4.6.5 and 4.6.9 of this work plan). Due to the close proximity of the northern of these two wells to the process line, this well will also provide data concerning contamination near the line. Consequently, data from

this well will be integrated into the investigation of the process lines.

4.6.17 Sanitary Sewer System and X-614P Northeast Sewage Lift Station

4.6.17.1 Unit Description

The sewage treatment system at PORTS consists of two pump stations, six lift stations, three separate septic tank systems, one active sewage treatment plant (X-6619), one non-operational sewage treatment plant (X-615), and gravity as well as forced-flow main sewer lines. The sanitary sewer system, including the X-614P lift station, has been in operation since 1954. The sewage system in Quadrant II consists of the X-614P lift station and several thousand feet of sewer lines.

To simplify the investigation, the sewer system in Quadrant II has been divided into three segments (Plates I and IV, Appendix A). Segment 1 includes the X-614P sewage lift station and associated lines along Defiance Avenue which serves the X-343 area. Segment 2 serves the facilities located along 16th and 18th streets from Pike Avenue east to the Perimeter Road. Buildings located along this line include X-105, X-345, X-700, X-705, X-720, and X-744G, H, and J. Segment 3 carries effluent from buildings located along 12th Street, including X-720.

The locations of sewer lines, as well as flow directions, are shown on Plate IV (Appendix A). Effluent from Segment 1 is transported west along 20th Street before eventually discharging into Segment 2 at the intersection of 10th Street and Pike Avenue. Segments 2 and 3 discharge into the main sewer line at the intersection of Pike Avenue and 15th Street.

The sanitary sewer system in Quadrant II consists of a network of four-, six-, eight-, ten-, and twelve-inch diameter lines composed of vitrified clay pipe. Rubber gaskets were used to connect the pipe and seal the junctions.

Normal operations at X-700, X-705, and X-720 are the primary sources for potential contaminants in the sanitary sewer system in Quadrant II. A list of potential contaminants which are used regularly at these facilities is listed in Table 4.2. Documented releases to the sanitary sewer system are presented in Table 4.3. Cleaning and plating solutions are discharged into a neutralization pit at the northeast corner of X-720. The neutralized solutions (50 gallons per month) are then flushed to X-6619. The laundry service at X-705 discharges detergents and related products to the sanitary sewer. Some of the floor drains at X-705 discharge into the sewer line. These drains are commonly used to dispose of solutions with uranium concentrations below the economically recoverable level (less than 400 gallons per month). X-614P is listed in USEPA and OEPA Consent Orders as requiring investigation.

4.6.17.2 Unit Investigation

Anticipated Site Geology

Boring logs for 701-39, -40, and -63, which are located southeast of Segment 1, indicate that the Minford clay has a thickness of 0 to 19 feet, and the Minford silt is 0- to 28-feet thick in this area. The Gallia occurs at depths of 30 to 34 feet. The Sunbury Shale, which 14-feet thick at 701-63, forms the bedrock surface and ranges in thickness from 5 to 15 feet in this area.

Well borings from 701-26, 701-27, 701-28, 701-29, and 701-45 indicate that in the vicinity of sewer segments 2 and 3 the Minford has a composite thickness of 28 to 34 feet. The thickness of the Minford silt is highly variable, ranging from 0 to 33 feet. The Gallia varies from 0 to 10 feet thick. The Sunbury Shale has an approximate thickness of 5 to 15 feet and forms the bedrock surface in the area.

Ground-Water Flow Directions

Ground-water flow in the Gallia near Segment 1 of the sewer line is to the southeast (Figures 4.1 and 4.2). A ground-water divide in the Gallia influences sewer segments 2 and 3. The divide passes through the northwest corner of X-720 and trends northeast/southwest through the northwest corner of X-744J. On the east side of the divide ground water flows to the southeast; flow on the west side is to the northwest. A water table mound exists in the Gallia southwest of X-720. As a result, flow near X-720 is dominantly to the northeast. Ground water in the Berea flows northeast in this area (Figure 4.3).

Thirteen soil borings will be drilled adjacent to the sewer line junctions to determine if contaminants have leaked from the sanitary system (Plates I and IV, Appendix A). Two borings will be drilled along both segment 1 and segment 3. Eight borings will be located along segment 2. One additional boring will be drilled next to the X-614P lift station.

During drilling of these borings, continuous soil samples will be taken from the ground surface to bedrock using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses, field radionuclide scans, and field pH measurements will be conducted at intervals of two feet. Every tenth sample will be sent to a laboratory for VOC analysis to provide a QA/QC check on field-GC results. Remaining samples will be stored on site for possible future analysis. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based on the field-GC results, selected samples will be sent to a laboratory for CLP Target Compound List and radionuclide analyses. Additional boreholes may be drilled to define the lateral and vertical extent of any soil contamination near the sanitary sewer lines.

To avoid damaging the sewer lines, engineering drawings of the sanitary sewer system will be obtained from the PORTS engineering department. The locations of the lines will be marked prior to any drilling activities.

If contamination is detected in soil samples collected below the water table, selected boreholes may be completed as monitoring wells. The wells will be sampled and analyzed for those constituents associated with leakage from the sewer lines. Additional wells may be installed, as necessary, to define the extent of ground-water contamination.

Boreholes adjacent to segments of the sewer lines at or below the Gallia water table which are not completed as monitoring wells will be completed as PVC-cased piezometers. This will allow determination of the effects of the sewer lines on ground-water flow in the Gallia.

4.6.18 Storm Drains D and E (East-Central Drainage Sector)

4.6.18.1 Unit Description

Storm drainage management at PORTS consists of a system of sewers, culverts, and ditches which collect surface runoff from the buildings and grounds on the plant-site and conduct the runoff to the natural drainage network. The storm drainage system in Quadrant II, including areas served by each segment and directions of flow, is illustrated on Plate V (Appendix A).

The east-central drainage sector, consisting of storm sewers D and E, drains the central portion of Quadrant II and discharges to the East Drainage Ditch. Storm Sewer D receives surface runoff from the X-700 Chemical Cleaning Facility and the X-705 Decontamination Building in Quadrant II (Table 4.4). Quadrant II facilities which contribute surface runoff to Storm Sewer E include the X-720 Maintenance Building, X-744G, H, and J Bulk Storage areas and X-747 A through E storage areas. Floor drains in X-705 and X-720 also discharge effluent to this storm sewer. Additional sources of outfall to Storm Sewer E, including those located outside Quadrant II, are listed in Table 4.4. A list of potential contaminants used regularly in Quadrant II is presented in Table 4.2.

Since the completion of these storm sewers in 1951, a variety of potential contaminants has been discharged to the system. In December 1985, 51,000 gallons of chromate water entered storm sewers D and E from the X-333 facility. Surface runoff entering these sewers may contain radionuclides from scrap yards as well as hazardous chemicals from spills. In addition, the X-720 cleaning area contributes 20 gallons/month of water with detergent, 500 to 600 gallons/month of water from a spray-painting booth, and 1200 to 1500 gallons/month of a caustic rinse solution (sodium hydroxide) that contains traces of grease from motor-cleaning operations.

4.6.18.2 Unit Investigation

Anticipated Site Geology

Boring logs for 701-26, -27, -28, and -29 indicate that the Minford is approximately 30 feet thick in this area. The Minford silt is uneven in thickness, ranging from 0 to 33 feet. The Gallia in the vicinity of Storm Sewers D and E ranges in thickness from 0 to 5 feet and is underlain by the Sunbury Shale which ranges in thickness from 5 to 15 feet in this area.

Ground-Water Flow

A ground-water divide in the Gallia, trending NE-SW, extends through the area influenced by Storm Sewers D and E (Figures 4.1 and 4.2). This divide passes through the northwest corner of X-720 and continues in a northeasterly direction through the northwest corner of X-744J. Ground-water flow on the east side of the divide is to the southeast; whereas flow on the west side trends to the northwest. Flow in the vicinity of X-720 is to the northeast as a result of a water-table mound located southwest of the building. Ground water in the Berea flows to the northeast in this area (Figure 4.3).

Soil/Backfill Sampling

To determine if hazardous constituents have leaked from the storm sewer piping, six soil borings will be drilled adjacent to the sewer lines at the following locations (Plates I and V, Appendix A); 1) south of X-720, 2) northwest of the intersection of 16th St. and Jackson Ave., 3) east of the intersection of Jackson Ave. and 18th St., 4) east of the intersection of Lawrence Ave. and 18th St., 5) northwest of X-705, and 6) northeast of the intersection of Pike Ave. and 16th Street. Engineering drawings will be used to determine the location of these lines, thus preventing damage to the pipe during drilling.

Continuous soil samples will be taken from the ground surface to bedrock using standard hollow-stem augering and split-spoon sampling techniques. Field-GC VOC analyses, field radionuclide scans, and field pH measurements will be conducted at intervals of two feet. Every tenth sample will be sent to a laboratory for VOC analysis to provide a QA/QC check on the field-GC results. All samples not sent to the laboratory will be stored on site for possible future analysis. Samples that are not analyzed within the permitted holding times will be disposed of by MMES in accordance with RCRA requirements.

Based upon the results of field-GC analyses, selected samples will be submitted for CLP Target Compound List and radionuclide analyses. Additional sampling locations may be selected to determine the extent of contaminant migration.

If contamination is detected, selected boreholes may be completed as monitoring wells. The wells will be sampled and analyzed for those constituents identified in the prior analyses. Additional wells may be installed, as required, to determine the extent of ground-water contamination.

Boreholes adjacent to segments of the sewer lines at or below the water table which are not completed as monitoring wells will be completed as PVC-cased piezometers. This will allow determination of the effects of the sewer lines on the flow of ground in the Gallia.

5. GROUND-WATER FLOW AND TRANSPORT MODELING

The modeling effort for Quadrant II will be similar in approach to that proposed for Quadrant I. Quadrant II modeling will consist of four phases, timed to start during Quadrant II data acquisition. The ultimate objective will be to develop a refined model covering the Quadrant II area which will predict both ground-water flow and contaminant transport. The transport modeling will be useful in estimating cleanup times and concentrations over time in recovery wells. Both will be useful in ranking remedial alternatives and in the engineering design for the CMS.

The four modeling tasks will include: 1) limited refinement of the site-wide model calibration, 2) construction of a Quadrant II submodel incorporating data collected during the Quadrant II field program, 3) development of a Quadrant II transport model, and 4) analysis of remedial alternatives. Task 1 will consist of a minor update of the site-wide model. (A major update will be performed during the Quadrant I investigation). Task 2 will be timed to coincide with the end of the Quadrant II field program. The new data collected during the field effort will be used to develop a subset of the site-wide model which will cover the Quadrant II area. Task 2 will also consist of minor recalibration of the submodel to account for the new data. A transport model will be constructed in Task 3 based upon the ground-water flow submodel developed in Task 2. Calibration of the transport model will not be attempted; rather, contaminants will be initialized in the transport model at current concentrations. Transport modeling will focus on analysis of the effects on contaminants of various remedial actions. Tasks 1 through 3 form the basis for analyzing remedial alternatives. Various alternatives will be investigated during task 4. The model will also be useful for the subsequent Quadrant II CMS.

6.0 RISK ASSESSMENT WORK PLAN

6.1 Introduction

The risk assessment work plan for Quadrant II of the Portsmouth facility described in this section delineates the process that will be used to assess risks to human health and the environment associated with potential current and future exposures to on-site and off-site substances released from the Portsmouth facility. The findings of the risk assessment will serve as guidance in determining the need for either interim remedial measures and/or a Corrective Measures Study.

The general risk assessment process described in this work plan will be applied to each of the four quadrants. Where available and relevant, information specific to Quadrant II is presented here. For purposes of the Quadrant II risk assessment, the estimated risks to the surrounding population and the environment will be based on releases from Quadrant II. The assessments for other quadrants will be handled similarly. As described previously, the quadrant boundaries were selected based on surface water drainage and ground-water flow divides. Therefore, for certain media, notably ground water and surface water, exposures to substances in these media (and corresponding risks) can be estimated reasonably well with quadrant-specific analysis. For other media, such as air, releases attributable to

different quadrants cannot be distinguished (e.g., monitoring data from an air monitoring station within Quadrant II or adjacent to the Quadrant II boundary will not necessarily reflect airborne emissions released exclusively or even predominantly from sources in that quadrant). Furthermore, the population receiving the highest exposure to substances released from Quadrant II via one pathway (e.g., inhalation of ambient air) might well be different from the population receiving the highest exposure to substances from the same quadrant via other media (e.g., ground or surface water). Limitations resulting from characterization of risks on a quadrant-specific basis, and methods to minimize these limitations, are discussed further in the risk characterization section.

Section 6.2 provides an overview of the methodology for assessing public health risk. Sections 6.3 through 6.6 describe in more depth the process by which risks to humans will be assessed; Section 6.7 describes the process for evaluating ecological risks.

6.2 Overview of Methodology for Assessing Public Health Risk

The risk assessment process used by federal regulatory agencies is essentially that described by the National Research Council (NRC 1983), and consists of the following four components:

- Hazard Identification: the review and critical evaluation of all data relevant to the toxic properties of a substance to identify the types of toxic hazards associated with it and the conditions of exposure (e.g., route, duration) under which it might occur.
- Dose-response Evaluation: the determination of the relationship between the magnitude of human exposure and the probability of occurrence (risk) of the hazard in question.
- Exposure Assessment: the identification of populations known to be potentially exposed to the substance and determination of the potential magnitude and duration of their exposures.
- Risk Characterization: the integration of hazard, dose-response, and human exposure information to develop estimates of the nature and magnitude of human risk.

In evaluating public health and environmental risks at hazardous waste sites, it is generally necessary to modify and expand the above process. In the public health risk assessment for the Portsmouth facility, the four step procedure shown in Figure 6-1 and described below will be used. This procedure is consistent with EPA guidance (EPA 1989a).

1. Selection of Indicator Substances. Because of the large number of substances detected in this quadrant, indicator substances will be selected to focus the assessment on those chemicals and radionuclides that are most likely to pose the greatest potential public health risk. Sampling from all environmental media will be reviewed. Indicator substances will be selected based on their frequency of detection, concentration, toxicity, environmental mobility, and persistence.

2. Toxicological Evaluation. The hazard identification and dose-response evaluation for each indicator chemical will be accomplished by using EPA's Reference Doses (RfDs) and slope factors* where they are available. An RfD is an estimate of a daily human exposure that is unlikely to result in deleterious effects following chronic exposure. A slope factor is the slope of a mathematical extrapolation curve and represents an estimate of the upper limit on lifetime risk per unit of dose. Where EPA has not developed an RfD or slope factor for an indicator chemical, appropriate toxicity values will be developed using a methodology consistent with EPA guidance. For radionuclides, inherent hazard will be characterized by use of available "risk coefficients," the equivalent to

* The slope factor has been previously referred to by EPA as a carcinogenic potency factor (CPF) (e.g., EPA 1986a).

slope factors for chemical carcinogens, or if not available, by use of the whole body dose-equivalent methodology and risk factors based on whole body irradiation by gamma rays.

3. Exposure Assessment. Developing estimates of potential exposure will be accomplished through the following three steps:

a) Identification of Exposure Pathways. Monitoring data for each of the environmental media (soil, surface water, ground water, air, and biota) will be reviewed to identify potential exposure pathways under current and potential future conditions of the site.

b) Estimation of Environmental Concentrations. In order to estimate the magnitude of potential exposures, concentrations of chemicals and radionuclides will be estimated for the various environmental media exposure pathways. To the extent available, measured concentration data will be used as a basis for estimating concentrations. In some cases, environmental fate and transport models will be used to estimate the chemical and radionuclide concentrations in environmental media.

c) Estimation of Human Dose. Estimates of concentrations of chemicals and radionuclides at the points of human exposure will be combined with exposure assumptions (e.g., the duration of exposure, the amount of the substance absorbed in the body, and the characteristics of the population receiving the exposure) to arrive at estimates of human dose.

4. Risk Characterization. Numerical estimates of carcinogenic and noncarcinogenic risks will be calculated for each substance by each potential route of exposure using the toxicity information and the human intakes estimated. As part of the risk characterization step, the uncertainties and limitations of the public health risk assessment will be discussed.

The methodology to be used in conducting a public health risk assessment for the site is consistent, in general principle, with the methodology outlined for the conduct of a Health and Environmental Assessment (HEA) in EPA's RCRA Facility Investigation (RFI) Guidance (EPA 1987a). In the HEA process, EPA states that, "potential human and environmental exposure routes are determined at actual or potential receptor locations for constituents in the release" and measured or predicted constituent concentrations in the release are ascertained. Second, health-based exposure-limit

criteria for different media are identified." Measured or predicted constituent concentrations in the release are compared to exposure-limit criteria. EPA (1987a, p. 8-1) notes that the criteria provided in their guidance document "do not necessarily represent clean-up target levels that must be achieved through the implementation of corrective measures." Rather, a finding of constituent concentrations in excess of the exposure-limit criteria would indicate that a closer examination was necessary, which would generally take place as part of a Corrective Measures Study (CMS).

In the risk assessment approach presented in the Portsmouth work plan, risks are evaluated in terms of the estimated dose received by the individual at the actual or potential point of exposure (typically in mg/kg/day) rather than in terms of the environmental concentration at the actual or potential point of exposure (expressed as a concentration in a given medium). The basic assumptions that determine levels of human intake and toxicity criteria for carcinogens and noncarcinogens are essentially the same in the two approaches. The approach taken in the current RFI work plan, however, is generally more comprehensive than the HEA process outlined in the RFI guidance document. The

"The HEA process for deriving exposure-limit criteria (expressed as concentrations in the media) is as follows: For carcinogens, exposure-limit criteria are derived from toxicity criteria (i.e., slope factors), acceptable risk levels of 10^{-6} for Class A and B carcinogens and 10^{-5} for Class C carcinogens, and a set of intake assumptions (e.g., water ingestion rate). For noncarcinogens, exposure-limit criteria are derived similarly from toxicity criteria (i.e., RfDs) and intake assumptions (EPA 1987a).

risk assessment would, therefore, meet the requirements for both the RFI HEA and the more rigorous assessment required for the CMS. To remain consistent with the HEA process outlined in EPA's RFI guidance document, a comparison of measured or predicted constituent concentrations and EPA-established exposure-limit criteria (including Maximum Contaminant Levels (MCLs), Ambient Water Quality Criteria and Health Advisories) will be conducted.

6.3 Selection of Indicator Substances

Data on potential contaminants present in Quadrant II of the site come from waste analysis studies of sludge from RCRA unit X-701B, Appendix IX analyses of ground water from wells in the vicinity of RCRA unit X-701B, and the identification of contaminants potentially released from units in Quadrant II. Available information on the nature and extent of contaminants present in Quadrant II is discussed in the Quadrant II Description of Current Conditions. Current site data indicate that 75 to 100 chemicals may have been released into the environment as a result of facility operations in Quadrant II. As is true of most hazardous waste sites, many of these substances are unlikely to contribute to public health risk because of an absence of an exposure pathway or low intrinsic toxicity. As EPA has noted (EPA 1989a), carrying a large number of chemicals through a quantitative risk assessment may be complex, resource intensive, and time consuming, and can result in a risk assessment report with an

unwieldy amount of data that detracts from dominant risks present at the site. Therefore, the public health risk assessment will focus on those chemicals and radionuclides likely to pose the greatest potential public health risks. A selection process will be applied to identify "indicator substances" that will be carried through the remaining steps of the public health risk assessment.

Application of an indicator substance selection process is consistent with guidance provided by EPA in the EPA Risk Assessment Guidance for Superfund (Volume I) (EPA 1989a). In reducing the number of substances to be carried through a risk assessment at a Superfund site, EPA guidance (1989a) recommends a selection process that takes into account:

- frequency of detection of the substance in the various environmental media;
- measured concentrations of the substance; and
- inherent toxicity of the substance.

In determining whether or not to remove a substance from the risk assessment, EPA (1989a) advises that consideration be given to:

- Historical information. Chemicals reliably associated with site activities based on historical information should not be eliminated.
- Toxicity. Chemicals of particular toxicological concern, such as known human carcinogens, should not be eliminated even if present at low concentrations or with low frequency.

- Mobility, persistence, bioaccumulation. Substances that are highly mobile, persistent, or readily bioaccumulated should not be eliminated.
- Special exposure routes. Certain exposure routes need to be considered for some substances that are not taken into account in a typical screening procedure (e.g., inhalation of highly volatile chemicals during showering).
- Treatability. Chemicals that are difficult to treat should be retained because of their importance during the selection of remedial alternatives.
- ARARs. Chemicals with Applicable and Relevant or Appropriate Regulations (ARARs) are generally not appropriate for exclusion.
- Essential nutrients. Chemicals that are essential nutrients, are present at low concentrations, and are toxic only at high doses generally need not be considered in the quantitative risk assessment.

Based on a preliminary review of the available site data, substances likely to be included among the indicator substances are: trichloroethene and other chlorinated solvents; polychlorinated biphenyls (PCBs); metals found in soil at concentrations above background; and radionuclides including technetium-99, uranium, and possibly some daughter isotopes of uranium. Chromium will likely be included if an analysis of air monitoring data indicate that this metal is present in cooling tower emissions. The final list of substances to be carried through the quantitative risk assessment for Quadrant II will be based on the results of field investigations for the quadrant. Determination of the need for limiting the number of chemicals to be carried through the assessment will be made after all field data

have been collected. An appropriate selection methodology will be developed by ENVIRON, in conjunction with Geraghty & Miller, which is consistent with guidance provided by EPA.

6.4 Toxicological Evaluation

A detailed description of the methodology to be used for deriving numerical toxicity values for the substances of concern in Quadrant II is presented in this section. Where available and appropriate, toxicity criteria derived by EPA--reference doses (RfDs) for the noncarcinogenic effects of substances and slope factors for carcinogens--will be used in this assessment. An RfD, generally expressed as a dose in mg/kg/day, is EPA's estimate of a daily human exposure that is unlikely to result in an appreciable risk of deleterious effects following chronic exposure (EPA 1989b). A slope factor, expressed in units of (mg/kg/day)⁻¹, represents the slope of the mathematical extrapolation curve in the low-dose region.

Reference will be made to EPA's RCRA Facility Investigation (RFI) Guidance (EPA 1987a), EPA's Integrated Risk Information System (IRIS), and EPA updates of Agency-approved toxicity values (EPA 1989c) for identification of EPA-established toxicity values. EPA Maximum Contaminant Levels (MCLs), Ambient Water Quality Criteria, and Health Advisories will also be identified as part of the evaluation of risks associated with potential drinking water

exposures. Where EPA values are not available, the dose-response evaluation process discussed below will be followed.

6.4.1 Introduction to Dose-Response Analysis

Toxicity data are first evaluated to ascertain the types of health effects that may be produced by exposure to the substances of interest. These data are evaluated to determine the quantitative relationship between the amount of exposure to a substance and the extent of toxic injury or disease. Next, on the basis of the toxicity data, quantitative measures of potential health effects are developed. Different methodologies are generally used to develop such measures, depending on whether a chemical is a carcinogen or a noncarcinogen.

Toxic effects other than cancer include such diverse responses as skin irritation, damage to specific organs (e.g., kidney, heart, and nervous system), and birth defects. Noncarcinogenic effects are generally thought not to occur until some minimum (threshold) level of exposure is reached. The principal exception concerns germ-cell mutations leading to adverse reproductive outcomes just as certain somatic-cell mutations can lead to cancer.

For noncarcinogenic effects of any given substance and route of exposure, both the severity and frequency of the effect in a population (i.e., the response) generally increase with increasing level of exposure (i.e., the dose). The type of adverse effect may also change with dose. For example, anesthetic gases may produce no detectable effect at low doses, produce headaches or lethargy at higher doses, induce sleep at still higher doses, and cause death at even higher doses. To the extent that the dose-response relationship is not well defined, uncertainty about the estimated risk will exist.

Exposure to carcinogenic chemicals or agents (i.e., radiation) for the purpose of this risk assessment is considered to pose some risk at any exposure level. With respect to radiation, only the excess or incremental risk (if any) above that caused by natural background radiation, which poses a quantifiable risk of its own, will be assessed. There will be no assumed background exposures to synthetic organic chemicals that have been identified in Quadrant II. The "no-threshold" assumption for carcinogens is based on current theories about the carcinogenic process for agents that affect genetic material, as is usually assumed for radiation. This assumption has been adopted by regulatory agencies with respect to carcinogenic chemicals as well. It is a conservative practice (i.e., will tend to overestimate true risk) because, for many chemicals, considerable evidence for a threshold exists. The non-threshold hypothesis is especially questionable for chemical

carcinogens that do not act directly on genetic material. The conservative "no-threshold" assumption, however, will be adopted with respect to all chemical carcinogens that are included in the Quadrant II risk assessment.

6.4.2 Acceptable Daily Intakes

As previously noted, noncarcinogenic effects are generally thought not to occur until some minimum (threshold) level of exposure is reached. Doses of a chemical that are not expected to result in adverse effects to humans are estimated and are referred to as acceptable daily intakes (ADIs) or reference doses (RfDs). [These terms will be assumed to be functionally synonymous, although RfDs are toxicity values specifically derived by EPA and may have received greater scrutiny than ADIs. The term ADI will be used here to distinguish those toxicity values for noncarcinogens developed by an independent review of the available toxicological literature from RfDs specifically derived by EPA].

RfDs for Quadrant II substances that have been developed and published by the EPA will be used in the risk assessment. In cases where there is no suitable RfD, an ADI will be calculated using the best available toxicity data and following the procedure that is outlined below. This is similar to the procedure described by the EPA in the Risk Assessment Guidance for Superfund (Volume I) (EPA 1989a) and RfD methodology (EPA 1989b).

When a no-observed-adverse-effect level (NOAEL) is available for a specific substance, the ADI is calculated by dividing the NOAEL derived from animal or human toxicity data by one or more uncertainty factors:

$$\text{ADI} = \text{NOAEL} / \text{Safety Factor}$$

The usual method for determining a NOAEL is to identify the highest dose within an experiment that causes no toxic effect. The next step is to identify the lowest NOAEL from among the various experiments performed on the most sensitive animal species. Preferably, the NOAEL used to derive the ADI is based on chronic (long-term) toxicity data; if no chronic toxicity data are available, subchronic data are used with the application of additional uncertainty factors.

Uncertainty factors adjust for various limitations in the available toxicity data. Recommended uncertainty factors of 10, 100, and 1000 are used to estimate ADIs depending on the available human or animal data (EPA 1989b; NRC 1977):

- An uncertainty factor of 10 is used when the NOAEL is based on chronic human data. This factor is meant to account for variation in sensitivity in the human population.
- An uncertainty factor of 100 is used when the NOAEL is based on chronic animal data. This factor is meant to account for both intra- and interspecies variability.

- An uncertainty factor of 1000 is used when the NOAEL is based on subchronic animal data. This factor incorporates uncertainty in extrapolating from subchronic to chronic exposures and includes the two previous uncertainty factors.

In cases where a NOAEL cannot be identified, the lowest-observed-adverse-effect level (LOAEL) is used to estimate the ADI. In such cases, an uncertainty factor ranging from 2 to 10 is used in addition to those mentioned above, depending on the severity of the effect observed. For example, an uncertainty factor of two is typically used for relatively mild effects, such as biochemical changes in blood parameters and reversible, mild organ changes.

6.4.3 Slope Factors

It is the common practice of regulatory agencies, in assessing the risk of carcinogens, to assume that there is essentially no level of exposure to a carcinogen that does not pose a finite probability, however small, of producing a carcinogenic response (i.e., that no threshold exists). Moreover, it is usually necessary to predict low-dose risk for human exposure to carcinogens from responses observed at high-doses. This can be accomplished through the application of a selected mathematical model to the dose-response data to produce an estimate of the excess cancer risk per unit of dose at low doses. This value is referred to as the slope factor. The "no-threshold" hypothesis has not been empirically verified for any carcinogen, although it has been shown to be plausible in large-scale studies of chemicals

(ED₀₁) and radiation (OSTP 1985). Rather, it is based on a hypothesis about the mechanism of carcinogenesis. It may be incorrect for many carcinogens but is often adopted in the interest of achieving maximum public health protection in the absence of complete scientific knowledge.

The EPA generally uses the linearized multistage model with data from animal experiments to estimate the 95% upper confidence limit on the slope of the dose-response curve at low doses. The resulting slope factor is expressed in units of (mg/kg/day)⁻¹. The risk assessment of carcinogenic chemicals that have been identified in Quadrant II will use slope factors that have been developed by EPA when available. If the Agency has not published a slope factor for a substance for which adequate carcinogenicity data are available, one will be derived using EPA methodology. As will be further discussed in the Risk Characterization section, the upper-bound probability of developing cancer is derived by multiplying an individual's lifetime average daily intake (LADI) for exposure to that chemical by the slope factor.

The assessment of risks from Quadrant II contaminants will also involve an estimate of risk resulting from exposure to the radionuclides of uranium and technetium-99 (⁹⁹Tc). The most prominent type of radiation from the decay of uranium is the alpha particle (a bare helium nucleus), whereas beta (electron) radiation is emitted from ⁹⁹Tc. Estimating the risk from exposure to

uranium"" (if this is necessary for Quadrant II) will make use of the available "risk coefficient," the equivalent of a slope factor, for use with radioactive substances. BEIR IV (NRC 1988) cites a uranium risk coefficient (for bone sarcomas) of 1.5×10^{-6} per pCi/day ingested over a lifetime for internally deposited uranium-natural. EPA has withdrawn its carcinogen assessment for uranium natural pending further review by the Agency. Assessing the risk associated with ^{99}Tc (a beta emitter) requires consideration of factors such as the radionuclide's pharmacokinetics and organ distribution as well as its biological and radiological half-lives. These data can be used to estimate an effective dose equivalent rate (mrem/yr) for exposure to a given amount of ^{99}Tc . The results of such a determination for ^{99}Tc in drinking water was published by the EPA in the Proposed National Primary Drinking Water Regulations for radionuclides (EPA 1986b).

This document lists a concentration of 5000 pCi/L for ^{99}Tc as yielding a risk equal to that from a dose rate of 4 mrem/year.

""The term "uranium" without further elaboration refers to "uranium-natural," i.e., a mixture of uranium isotopes in approximately their natural abundance ratios. Should the uranium in environmental samples prove to have different abundances, adjustments in the risk coefficients will be necessary.

6.5 Exposure Assessment

6.5.1 Introduction

Exposure assessment involves describing the nature and size of the various populations potentially exposed to substances in their environment and the magnitude and duration of their exposures. For purposes of this plan, the exposure assessment process consists of the following steps:

- Identification of human exposure pathways (including identification of a source and mechanism of release of the contaminant, an environmental transport medium or media, a potential human exposure point, and a likely route of exposure).
- Estimation of concentrations of substances of concern at the exposure points (by use of monitoring data and/or mathematical models to predict the distribution of substances in specific media).
- Estimation of human dose or intake (in which estimates of contaminant concentrations at the exposure points are combined with various exposure assumptions (e.g., the duration of exposure, the amount of chemical absorbed into the body via inhalation, ingestion, or dermal absorption, and the characteristics of the population receiving the exposure) to arrive at estimates of human intake).

The exposure scenarios described in this chapter are those that represent conditions under which people in the vicinity of the Portsmouth site may be exposed to chemicals released from the site. The baseline evaluation of potential exposures will consider potential exposures under both current and future use conditions. Current use scenarios will be developed based on current local

demographics and land use. Consistent with current security measures and restrictions on access to DOE property, no public access to the site that could result in any significant direct contact with contaminated on-site media will be assumed under the current use scenario.

Future use scenarios will be developed using the conservative assumption of essentially unrestricted access to the site. Specifically, it will be assumed that at some point in the future, operations at the Portsmouth facility will be shut down and current DOE property will be made available for residential development. It will be further assumed that residential development will occur only outside the boundary of the individual solid waste management units (SWMUs). Because any future development immediately on top of the SWMUs is extremely unrealistic, direct contact with these areas will not be modeled. A more likely future use scenario is that residential development could occur closer to the Portsmouth facility but still outside the current facility boundary. Therefore, the evaluation of future conditions of the site will also include a scenario of residential development at the facility boundary. For such development to occur, it is not necessary to assume that operations of the facility have ceased. In developing the future use scenarios, it will be assumed that the site will generally remain rural, since the facility is not near any expanding urban areas (see Quadrant II Description of Current Conditions).

In summary, the basic exposure scenarios that will be modeled in the Portsmouth risk assessment are as follows:

Current Use Scenario

- "Current off-site resident"

Residential population characterized by current demographics and land use.

Future Use Scenario

- "Future on-site resident"

Resident located on-site but outside the boundaries of the SWMUs. Under this scenario, the facility would be assumed to be no longer in operation.

- "Future off-site resident"

Resident located at the current boundary of the Portsmouth site. Under this scenario, it would be assumed that the facility was still in operation.

For each exposure scenario, "average" and "reasonable worst case" exposures will be estimated (EPA 1988a,b). The average case will represent the exposure of an individual with normal activity patterns and, to the extent possible, will make use of exposure assumptions considered to be best estimates. The reasonable worst

case will be developed to provide a more conservative but still plausible upper bound on exposure. The set of exposure assumptions used to model a reasonable worst case exposure is to be distinguished from a true worst-case scenario. One form of the worst-case scenario is the maximally exposed individual, i.e., a single individual with the highest exposure. As noted by EPA (1988a,b), the worst-case scenario generates exposure estimates at the top end of the distribution of exposures in a population, if indeed such an exposure exists, and cannot be used legitimately to prove that a real concern for public health exists.

Exposure estimates under both current and future use scenarios will be based on current conditions at the site. In Quadrant II, however, closure activities are underway for the RCRA unit located in this quadrant (X-701B holding pond). In developing estimates of potential migration of substances (notably TCE) from the site, the outcome of closure activities on this unit as a source of contamination to ground water or air will be taken into account by reducing the magnitude of the source term in the media concentration models before assessing potential future exposures associated with this quadrant.

The remainder of this section describes the process of exposure assessment as it will be applied to Quadrant II of the Portsmouth site.

6.5.2 Identification of Human Exposure Pathways

Substances present on the Portsmouth site have the potential to migrate through the environment. Therefore, human exposure may occur through a variety of direct and indirect pathways. The potential pathways of exposure that will be considered in the RFI of Quadrant II are discussed below. These pathways will be further examined for their significance to potential human exposure in the RFI. Those pathways found to be unlikely pathways of current or future exposure will not be included in the risk assessment.

This preliminary identification of pathways by which humans may become exposed to substances associated with Quadrant II of the Portsmouth site is based on knowledge of the area demographics and use of the surrounding land. A description of local demographics and land use is contained in the Quadrant I Description of Current Conditions. At present, however, detailed knowledge of the off-site area with the greatest potential to be impacted by Quadrant II (i.e., the area generally to the east of the site) is limited. More information about the population living closest to Quadrant II, land use (e.g., use for farming or raising livestock), and use of surface or ground water (e.g., for recreational uses, drinking water) will be gathered during the actual RFI to refine the exposure assessment. In general, the exposed population in the current use scenario will be considered to be local residents located to the east of the site (i.e.,

property adjacent to the Quadrant II boundary of the facility). In the future use scenario, exposures to individuals assuming on-site residential development will additionally be considered.

6.5.2.1 Soil and Sediment Pathways

Exposure to substances in soil and sediments may occur through unintentional ingestion and through dermal contact. Available monitoring data suggest that off-site soils are not contaminated. Therefore, it is anticipated that dermal contact with and ingestion of soil will not be included among the pathways of exposure in the current use scenario. However, if further field investigation provides evidence of off-site soil contamination, consideration of these pathways will be given for individuals who may come into contact with off-site residential soils or with sediments in surface waters that drain Quadrant II (Little Beaver Creek). Dermal contact with and ingestion of on-site soils and sediment will be considered among the pathways of exposure in the future use scenario.

6.5.2.2 Air Pathways

Substances of concern may be released to the atmosphere from cooling towers and other units from which vapors or aerosols may be emitted. These releases may present a potential exposure for current and future off-site residents. Because it is assumed that

the facility would not be in operation if the site were developed as residential property in the future, any releases from cooling towers or other operating units would not be of concern in modeling exposure to the future on-site resident.

Volatile chemicals in the soil may be released through volatilization. Fugitive dust may also be generated at the site by wind erosion and vehicular traffic. These airborne releases could present an inhalation exposure for current and future residents located downwind of the sources. In assessing the air pathway, meteorological conditions (e.g., direction and velocity of prevailing winds) will be taken into consideration in determining the nature and extent of inhalation exposures.

6.5.2.3 Surface Water Pathways

Substances associated with the facility can potentially be released to surface waters from ground water discharge, overland runoff, and atmospheric deposition. Little Beaver Creek, the surface water body that drains Quadrant II, is highly unlikely to serve as a human drinking water source. Human exposure to substances in the creek could more likely occur as a result of direct dermal contact during recreational activities. Use of the creek for various recreational activities (e.g., wading, swimming, fishing) will be further investigated to refine the nature of potential exposures. It should be noted that contamination of

Little Beaver Creek with trichloroethylene (TCE) has been documented; however, the concentration of TCE in the creek drops below the detection limit within the DOE property boundary. Under current conditions, human exposure to TCE or other potential contaminants in Little Beaver Creek may not occur. The creek may be a potential source of exposure, however, in the future on-site scenario.

Indirect exposure may also result from consumption of fish that have bioaccumulated substances of concern present in surface waters. Whether Little Beaver Creek supports fish populations in areas potentially contaminated by releases from the site requires further investigation.

6.5.2.4 Ground Water Pathways

Extensive ground water monitoring conducted to date suggests that ground water contaminant plumes have not migrated off-site. Therefore, for those current off-site residents who have private wells, use of ground water as a drinking water source may not present any current exposure. In the future, however, off-site migration of contaminant plumes could occur and present a drinking water exposure. Well logs for private residences are available and will be further examined in the RFI to assess the possibility of future off-site drinking water exposure. Because on-site ground water is known to be contaminated, the use of ground water would

present a potential exposure pathway for future on-site residents. Data from ground water wells in the proximity of SWMUs would be used to evaluate potential exposures for future on-site residents.

6.5.2.5 Food Pathways

Exposure to substances associated with the site could potentially occur through a variety of food pathways. Much of the land in Pike County is farmland. Beef cattle are raised in the county, but no dairy cattle are currently raised locally. Cattle or other livestock could potentially bioaccumulate contaminants present in soil, sediments, forage material, locally-grown feed, or surface and ground water used to water the livestock. The extent to which these pathways result in potential current or future exposures to substances released from the site will be further investigated in the RFI. If the potential for accumulation by plants of substances released from the facility is demonstrated, it is anticipated that exposure via consumption of locally raised beef will be evaluated in the current use scenario, and that exposure via consumption of locally raised beef and dairy products from locally raised dairy cattle will be evaluated in the future use scenarios. Accumulation in animal tissues is likely to be significant only for highly lipophilic substances that are not susceptible to metabolism.

Crops consumed by humans could also bioaccumulate contaminants present in soil or in water used for irrigation. It is not known whether surface or ground water is currently used for irrigation or could be used in the future. If the potential for accumulation by plants of substances released from the facility is demonstrated, it is anticipated that exposures would be modeled in the context of a home garden.

Local game could also bioaccumulate substances released from the site from ingestion of contaminated media. Exposure via consumption of game will be further investigated if hunting on property impacted by the facility is shown to be an activity of local residents.

6.5.3 Estimation of Environmental Concentrations

Estimation of environmental concentrations of the substances of concern at the points of actual or potential human contact can be accomplished by two basic approaches: measurement and modeling. These two approaches are complementary and each has its advantages.

Ideally, one would like to be able to measure the concentration of the substances of concern in the ambient media at the points of human contact. Measurement of concentrations at every point of every medium at which people could be exposed, however, is technically and economically impossible. Furthermore,

monitoring does not provide direct measurements of concentrations relevant to potential future exposures.

An alternative or supplement to monitoring is to mathematically predict or model, the concentrations in media to which people could be exposed. Models are mathematical abstractions that predict concentrations from more fundamental and more easily measured information. For example, a substance of concern in ground water may discharge into surface water and may be bioaccumulated by fish. Given information on ground water discharge rate, surface water flow rate, and relative distribution between water and fish tissue (e.g., bioaccumulation factor), the concentration in fish can be predicted. In this way, a series of models can be used to predict the concentrations in surface and ground water, soil, air, and food.

A summary of the available monitoring data for the Portsmouth facility and environs are presented in the Quadrant II Description of Current Conditions. In analyzing the monitoring data for purposes of risk assessment, the frequency and density of samples at various locations, as well as the importance of each location, will be taken into account in estimating environmental concentrations and in assessing the degree of confidence with which the results obtained for selected samples represent the medium as a whole. Simple use of arithmetic or geometric means may underestimate the total impacts of the substances present for

certain members of the potentially exposed population, but use of maximum concentrations would surely exaggerate the risk. ENVIRON and Geraghty & Miller will work with Martin Marietta on a scheme for best representing the observed data.

Thorough characterization of the site will be conducted during the RFI, and will supplement the available monitoring data. For some of the pathways of potential human exposure identified in Section 6.5.2, monitoring data may be insufficient, even after completion of the site characterization, to define the concentrations in the media at the receptor locations, particularly for estimates of future exposures. To the extent necessary, modeling of concentrations in the primary media (air, ground water, surface water, soils) and secondary media (crops, beef, milk, fish) will be accomplished with fate and transport models recommended by EPA or with other generally accepted models.

6.5.4 Estimation of Human Intake

Given the concentrations of substances in the various media at the point(s) of human contact, estimates of human dose can be derived.

In chemical risk assessment, dose (more precisely, dose rate) is the amount of a substance taken into the body per unit of body weight per unit of time. The usual expression of chemical dose is

milligram (mg) of substances per kilogram (kg) body weight per day. The concept of dose is somewhat different for radioactive substances. Strictly speaking, radiation dose is a measure of energy deposition per unit mass, usually expressed in rems or sieverts. Doses and dose rates (mrem/yr) may be estimated from knowledge of the daily intake.

Two aspects of the exposed population need to be considered in estimating human intake: demographics and activity. The composition of the population will determine certain physiological parameters that affect exposure. For example, the body weight and breathing rate of an adult male, adult female, and child differ. The type of people in the exposed population may also determine their activities and may, therefore, affect their extent of exposure. Children, for example, are more likely to play in or ingest soils than are adults. The potentially exposed residential population will likely be divided into five age groups: adult male (18 to 72 years), adult female (18 to 78 years), fifteen-year-old (average of ages 12 to 18), nine-year-old (average of ages 6 to 12), and four-year-old (average of ages 2 to 6).

The method for calculating intake depends on the route of exposure. For example, to calculate intake from inhalation of vapors, it is necessary to know the concentration of the substance in air, the breathing rate of the person, the fraction of inhaled substance absorbed through the walls of the lung, the fraction of

the time that the person could be exposed, and the weight of the person. For substances that are ingested or that pass through the skin, different factors (e.g., gastrointestinal absorption factors, skin penetration rates, etc.) determine intake. Different measures of dose are required for carcinogens and noncarcinogens, as described below.

6.5.4.1 Estimation of Intake for Carcinogens

Observations of carcinogenic effects in humans and in laboratory experiments show that cancer commonly takes a long time to develop, usually a large portion of a lifetime. The methods that have been developed to estimate carcinogenic risk involve averaging the cumulative total exposure over the lifetime of the animal or person. The resulting measure of exposure is the lifetime average daily intake (LADI) of a particular carcinogen or its analogue for a radioactive substance. LADI values for the average and reasonable worst-case exposure scenarios will be developed.

For example, one would calculate the LADI of a chemical carcinogen that would result from drinking water containing that chemical daily, over a lifetime, as follows:

$$LADI = \frac{C_w \times W_c \times A_i \times D_e}{D_l \times B_w}$$

where

C_w = concentration of chemical in water, mg/l

W_c = water consumption rate, l/day

A_i = ingestion absorption factor, unitless

D_e = days exposed in a lifetime, days/life

D_l = lifetime days, days/life

B_w = body weight, kg

For uranium-natural, the calculation of risk is somewhat simplified because the absorption factor is incorporated in the risk coefficient and a constant daily intake is assumed. For the same drinking water example, the daily intake, DI, in pCi/l, is simply given by:

$$DI = C_w \times W_c$$

where

C_w = activity of uranium-natural in water, in pCi/l

W_c = water consumption, l/day

For other radioactive substances, the risk coefficients may be expressed in terms of mrem/yr and the corresponding doses must be estimated.

6.5.4.2 Estimation of Intake for Noncarcinogens

Noncarcinogenic effects are assumed to have a threshold below which no adverse effect is observed. Consequently, in order to assess potential risk from exposure to a noncarcinogen, the appropriate dose measure is the chronic daily intake (CDI). The averaging time over which exposure will be estimated depends on the type of toxic effects being addressed. Recent EPA guidance (EPA 1989a) suggests that the intakes associated with longer term exposures to noncarcinogenic substances be averaged over the period of exposure. When developing exposure intakes for developmental toxicants, the intakes would generally be calculated by averaging over the exposure event (e.g., a day). In the assessment for the Portsmouth site, CDI values will be developed using average and reasonable worst-case exposure assumptions. The CDI measure differs from the LADI, which is used to assess carcinogenic risks, in that exposures are averaged over an appropriate period of exposure associated with the toxic effect being addressed and not necessarily over a lifetime, the averaging period for the LADI.

As an example, the CDI that would result from drinking water containing a specific noncarcinogen can be calculated as follows:

$$CDI = \frac{C_w \times W_c \times A_i}{B_w}$$

where

C_w = average concentration of chemical in water over the period of exposure, mg/l

W_c = water consumption rate, l/day

A_i = ingestion absorption factor, unitless

B_w = body weight, kg

Assumptions used to estimate human intake will be consistent with assumptions used by EPA and in particular those exposure parameters recommended in EPA's recently published Exposure Factors Handbook (EPA 1989d). Where EPA has not developed exposure assumptions needed to estimate potential exposure, assumptions developed and justified by ENVIRON will be used; many of these parameters are derived from the "Reference Man" report (ICRP 1984). Table 6.1 has a list of standard assumptions used by ENVIRON for each of the exposure scenarios that may be included in the RFI risk assessment. These exposure assumptions are organized and supplied by ENVIRON's Exposure and Risk Modeling Assistant (ERMASM) computer system for conducting risk assessments. ERMASM will also be used to organize and display the principal risk calculations, after site specific data and assumptions have been incorporated into the program.

6.6 Risk Characterization

In the final step of the risk assessment process, numerical estimates of risk are calculated for each substance of concern by each potential route of exposure, on the basis of the toxicologic dose-response relationships and human intakes estimated for each exposure scenario. The risk assessment will estimate risks under both average exposure and reasonable worst case exposure conditions.

6.6.1 Noncarcinogens

As mentioned previously, noncarcinogens will be treated differently than potentially carcinogenic substances. The numerical estimate of risk for noncarcinogens and for the noncarcinogenic effects of potentially carcinogenic substances will be determined by comparing the estimated exposure for each chemical (i.e., the CDI) to the RfD (or ADI where EPA has not developed a toxicity value for noncarcinogenic effects). If the estimated exposure (CDI) is below the RfD (e.g., CDI-to-RfD ratio less than one), exposure to the individual substance is judged unlikely to result in a toxic effect. As a gross indicator of the possibility of toxic effects because of cumulative exposure to all chemicals at the site, the ratios of CDIs to RfDs for all chemicals can be added. This summed ratio is called the Hazard Index, or HI (EPA

1986c). The HI approach assumes that multiple sub-threshold (below the RfD) exposures could result in an adverse effect and that a reasonable criterion for adverse effects is the sum of the ratios of the sub-threshold exposures to acceptable exposures (EPA 1986c). The HI is expressed as follows:

$$HI = E_1/RL_1 + E_2/RL_2 + \dots + E_i/RL_i$$

where

E_i = Exposure level (or intake) for the i^{th} toxicant

RL_i = Reference level (or ADI) for the i^{th} toxicant

If the sum of the ratios is less than one, cumulative exposure to the substances of interest at the site is judged unlikely to result in an adverse effect. If the sum is greater than one, a more detailed and critical evaluation of the risks, including consideration of specific target organs affected and mechanisms of toxic action of the substances of interest, is required to ascertain if the cumulative exposure would in fact be likely to harm exposed individuals. For multiple chemical exposure, the HI can, in principle, exceed one even if no single chemical exceeds its acceptable level.

The assumption of additive effects reflected in the cumulative HI is most properly applied to substances that induce the same effect by the same mechanism (EPA 1986c). Consequently, application of the equation to a mixture of substances that are not expected to induce the same type of effects could overestimate

the potential for adverse health effects. The HI provides a rough measure of potential toxicity, but it is conservative and dependent on the quality of the experimental evidence. Since the HI does not define dose-response relationships, its numerical value should not be construed as a direct estimate of risk (EPA 1986c).

6.6.2 Carcinogens

For any carcinogenic chemicals identified at the site, risk will be calculated by multiplying the LADI (in mg/kg/day) by the slope factor (in $[\text{mg/kg/day}]^{-1}$). The result is an upper-bound estimate of the lifetime cancer risk attributable to exposure to the carcinogen. Risk is a measure of probability and is a pure number without units. A lifetime increased cancer risk of one-in-one-million (10^{-6}), for example, indicates that one additional case of cancer per lifetime might be incurred for every one million people exposed to that concentration of substance under the assumed exposure conditions. Cancer risks associated with each exposure scenario will be summed for all substances and by pathway to estimate total cancer risk.

For the carcinogenic risk of uranium-natural specifically, the daily intake (in pCi/day) is multiplied by the appropriate risk coefficient (in $[\text{pCi/day}]^{-1}$) as given in BEIR IV (NRC 1988). The risk from ingestion of other radionuclides such as technetium-99 will be determined by converting the intake rates to internal dose

or the equivalent whole body gamma radiation dose using the assumptions as given in such references as ICRP 30 (ICRP 1978) and BEIR IV (NRC 1988) and then multiplying by the appropriate risk coefficients. The interpretation of risk is the same as for carcinogenic chemicals.

It must be emphasized that the risk estimates produced by the methods described above are hypothetical, in the sense that the risk estimates are usually based on exposures producing risk estimates below observable levels. This means that they are risks that have not been directly observed and that are not subject to empirical verification. Risk estimates are nevertheless useful for risk management because they are based on a systematic evaluation of existing data and are consistent with current (though in some cases limited) scientific knowledge.

6.6.3 Uncertainty

A critical factor in risk characterization is a description and quantification (to the extent possible) of limitations and uncertainties in the risk assessment.

Uncertainties associated with both the toxicological evaluation and exposure assessment steps of the risk assessment process can be divided into two categories: 1) uncertainties inherent in the current state of knowledge; and 2) uncertainties

resulting from deficiencies in available data. Uncertainties and limitations in the toxicological evaluation may result from:

- Limited toxicological data for the chemical, route, and duration of exposure relevant to actual human exposure conditions.
- The extrapolation of toxicity data from animals to humans.
- The extrapolation of dose-response data associated with high exposure levels to predict risks at low doses.
- The possible biological interaction of effects from exposure to mixtures of chemicals.

Uncertainties and limitations in the exposure assessment may be associated with:

- Quality of the environmental sampling and analysis.
- Environmental fate and transport models.
- Data on site-specific environmental conditions.
- Characterization of local demographics and human activity patterns leading to potential exposure under current and future use conditions.

The existence of uncertainty should be noted in the interpretation of the results of any risk assessment.

One of the uncertainties or limitations of conducting analyses of risk for individual quadrants of the Portsmouth site concerns whether or not the total exposure via multiple pathways (and hence total risk) will be appropriately characterized. As noted in Section 6.1, the population living closest to a particular quadrant

may not necessarily receive emissions released exclusively or even predominantly from that quadrant. This is particularly true of airborne emissions, for which the highest potential exposures will be received by residents downwind of the source. Estimates of potential exposure to substances of concern based only on sources in the quadrant being addressed in the RFI for that quadrant could, therefore, underestimate total exposure and risk. This is particularly critical in the evaluation of noncarcinogenic endpoints, where thresholds are believed to exist. Theoretically, exposures from sources in different quadrants could individually be less than the RfD, but combined could exceed the RfD and thereby potentially present a level of unacceptable risk.

To the extent possible in each quadrant-specific risk assessment, characterization (qualitative or quantitative) of significant exposures from other quadrants will be addressed. Alternatively, an additional risk assessment could be conducted, if necessary, after completion of the four quadrant-specific assessments, with the purpose of developing estimates of total exposure (and corresponding risk) for the populations living in the vicinity of the facility. A final decision on whether or not additional characterization of total risk from facility emissions is necessary will be made after more complete site characterization data are available.

Another area of uncertainty in the Portsmouth risk assessment will be associated with limitations in knowledge of potential current, and to a greater extent, future exposures. As the exposure scenarios are refined during the RFI, additional data collection may be recommended to reduce uncertainty in estimates of potential risk. Data collection efforts could include, for example, additional sampling and analysis of selected media, literature reviews to refine various absorption coefficients, or additional information on the demography of the surrounding area.

A discussion of the nature and magnitude of the uncertainties in risk associated with the Portsmouth site will be provided in the RFI.

6.7 Ecological Risk Assessment

6.7.1 Introduction

The area on and around the Portsmouth site provides diverse habitats for various plant and animal species. To the extent feasible given the limited data on the effects of substances on environmental receptors, the principles of risk assessment developed for human risk assessment will also be used to evaluate the potential effects of various remedial alternatives on local flora and fauna.

An environmental risk assessment will be conducted with the understanding that such an analysis is in many ways more complex than an analysis of risks to human health. Different study areas typically support a number of species inhabiting different niches in one or more ecosystems. Because current understanding of higher levels of organization in the environment (i.e., ecosystems) is insufficient to support the application of risk assessment, quantitative assessments of environmental risk are generally limited to estimating effects on individual species (Norton et al. 1988). Such an approach will be used in the environmental risk assessment of the Portsmouth facility.

The procedure that will be used to assess environmental risks is similar to that described previously for the human health risk assessment and will include the following five steps:

- Identification of substances of concern
- Identification of selected indicator species
- Evaluation of the potential effects of substances on indicator species
- Exposure assessment
- Risk characterization

This methodology is similar in concept to those employed by EPA's Office of Pesticide Programs (EPA 1986d) to estimate the potential ecological impact of pesticides, EPA's Office of Toxic Substance's method for estimating "concern levels" (EPA 1984), and

EPA's Office of Solid Waste's method for evaluating risk from hazardous waste tanks (EPA 1987b). For instance, in the approach used by the Office of Pesticide Programs, the estimated environmental concentrations of the chemicals of concern are compared with chronic effect levels for aquatic and terrestrial organisms.

The remainder of this section presents a discussion of the five-step procedure that will be used to assess environmental risks associated with substances released from the Portsmouth facility.

6.7.2 Selection of Substances of Concern

Those substances evaluated in the human health risk assessment will also be considered as candidate substances for evaluation in the ecological risk assessment. Because of the general paucity of data for many contaminant/receptor combinations, it may not be possible to include in the ecological risk assessment all those substances for which a human health risk assessment will be conducted. It is possible that some substances that present minimal risks to public health and for that reason were not included in the human health risk assessment might present more serious impacts on the environment. Such substances will be considered in the ecological risk assessment.

6.7.3 Selection of Indicator Species

The second step in the environmental risk assessment will be to select certain species, referred to here as indicator species, upon which the environmental risk assessment will be based.

Selection of indicator species requires that a species inventory of the area be conducted. An overview of local flora and fauna is contained in the 1987 Environmental Surveillance report (Martin Marietta 1988). According to this source, local fauna is typical of southern Ohio and contains no known threatened or endangered species. Dominant mammalian populations include white-tailed deer, eastern cottontail rabbit, squirrels and muskrats. Most important among the bird species are mallards, wood ducks, bobwhites, pigeons, and mourning doves. Bullfrogs, black rat snakes, and northern black racers are numerous; also present are other snake species, turtles, frogs, and toads. Little Beaver Creek, Big Run Creek, and other local small streams support fish populations that are typical of headwater-type streams, including carp, shad, bluegill, and various minnows and darters. In the larger streams, Big Beaver Creek and the Scioto River, fish populations are more abundant and diverse and include catfish, suckers, sunfish, trout, and bass.

Some livestock are raised in the area, including beef cattle, horses, pigs, sheep, goats, and chickens.

Commercial woodlands are mostly saw timber, with somewhat fewer pole-timber stands. In the natural forests, tree cover is predominantly white oak, red oak, and hickory, mixed with smaller populations of maple, ash, pine, and sycamore. Lesser stands of pine or black locust dominate very dry or infertile soils, and logged regions support young oaks, hickories, and numerous brambles. Most common in the subcanopy growth are sumac, poison ivy, and blackberry.

Because of the number of species potentially present on and around the site and the anticipated limitations in species-specific data (both data on a species' sensitivity to a particular substance and its potential for exposure), it will not be feasible to evaluate each species that may be present in the area. The following factors will be used, therefore, in the selection of indicator species:

- Rare, threatened, or endangered species. The available information indicates that no threatened or endangered species are native to this region of Ohio. However, should such a species be identified in the region, an effort will be made to include it, or a closely related species, among the indicator species.
- Presence of the species in the site vicinity. Consideration will be given to those species that are found in the site vicinity over most of their lifespan.
- Representation of significant aquatic and terrestrial environments. An effort will be made to select a range of species that will permit consideration of all contaminated media and all major routes of exposure. Thus, both aquatic species and terrestrial species will be considered in the assessment.

- Relative sensitivity. The relative sensitivity of the various candidate species will be an important factor in the selection of indicator species. Emphasis will be placed on selecting species that have been shown to be more sensitive to the biological effects of substances released from the facility.
- Economic and societal value. In the selection process, greater emphasis will be placed on those species that are generally considered to be of greatest economic and recreational importance (e.g., livestock, crops, and game such as deer, ducks, and fish).
- Availability of data. Data on effects of most environmental contaminants specific to many native species are unavailable, and a risk assessment based on such species would provide few meaningful conclusions. Therefore, the assessment will focus on those species for which sufficient data on the effects of substances of concern are available.

Indicator species will likely be selected from the following categories: livestock (probably beef cattle), terrestrial mammals, birds, aquatic species, and plants. If relevant data for other environmental species and the chemicals of concern are identified in literature searches performed as part of the environmental assessment, these data will be considered in the environmental assessment.

6.7.4 Evaluation of the Potential Effects of Substances on Indicator Species

The available environmental effects data on substances of concern will be compiled and reviewed in order to determine the nature of the effects that have been observed in plants and animals following exposure, and the no-observed-effect level (NOEL) associated with exposure for each of the indicator species. It is

anticipated that any environmental risks posed by the facility would be due to low-level chronic releases. Emphasis will be placed, therefore, on the chronic effects of the substances released from the facility. It is considered unlikely that conditions will exist under normal operating conditions that would pose acute risks to environmental species. Should such scenarios be identified during the RFI, the acute toxicity of substances of concern will be characterized.

For each of the indicator species, the NOEL from the most sensitive study for a given substance for that species reported in the available literature will be identified. Where this NOEL represents a dose (e.g., milligrams of contaminant per kilogram body weight per day, or mg/kg/day), as in the case of birds and mammals, it will be referred to as the criterion dose. For other species (e.g., fish and plants), where the effects of chemicals are typically evaluated in terms of concentrations of the chemical in media such as water or soil (e.g., mg/liter of water or mg/kg soil), the NOEL associated with chronic exposures will be referred to as the criterion concentration. For aquatic life, EPA water quality criteria for the protection of freshwater aquatic life will be used unless more recent data clearly support some other concentration as protective of aquatic life.

Because of limitations in the available ecotoxicity data base for most substances, it is anticipated that study data will not provide a measure of the chronic NOEL for all indicator species. For some indicator species, a lowest-observed-effect level (LOEL) will be identified and used to estimate a NOEL (e.g., through the application of appropriate uncertainty factors). It is likely that it will be necessary to use data (i.e., NOELs and LOELs) for indicator species that were derived from less than chronic exposures. For evaluating aquatic effects, there is established precedent for using short-term testing (7 to 11 days) that expose the most sensitive life stage (e.g., larvae) to estimate chronic effect levels (Barnthouse 1986). For other indicator species, it will not be possible to apply directly the results of short-term testing to estimate acceptable chronic exposure levels. In such cases, the relevant NOELs or LOELs may be adjusted to better approximate acceptable chronic levels.

Only threshold effects of the substances of concern will be evaluated for purposes of deriving a criterion dose or concentration. Endpoints generally treated as nonthreshold effects in human risk assessments (notably carcinogenic effects) will not be used in the environmental assessment because no generally accepted methods for interpreting nonthreshold risks (i.e., cancer risk levels) in animals have been developed.

The substantial existing literature on radioecology will be reviewed to assess the potential impacts of radionuclides released from the site on the environment. This review is expected to focus on research conducted at Oak Ridge, Brookhaven and Pacific Northwest National Laboratories. The concentrations of radionuclides measured or predicted in ambient media will be compared with concentrations thought to be harmful. Few data are expected to be directly relevant to radionuclides associated with the Portsmouth facility.

Literature on the effects of cooling tower drift containing chromium on the terrestrial environment will also be reviewed. This literature is based on numerous investigations conducted at the Department of Energy facilities (gaseous diffusion plants) in Paducah, Kentucky and Oak Ridge, Tennessee (Taylor 1980). Investigations at these sites have focused on the release, environmental fate, and environmental impacts of chromium and zinc.

For most site contaminants, the environmental effects database will be sparse. Therefore, it may be necessary to estimate the criterion dose or concentration for some indicator species by using data obtained from a related species. It is also anticipated that it will be necessary to use data obtained using laboratory strains to predict the response of species found in the wild.

6.7.5 Exposure Assessment

As previously noted, it is anticipated that any environmental risks associated with the facility would be due to low-level chronic releases. Accordingly, the environmental risk assessment will focus on long-term (chronic) exposures of indicator species to substances released from the Portsmouth facility. Consideration will be given, however, to identification of any acute exposures that might be associated with facility releases.

All pathways believed to represent potentially significant exposure routes will be considered for each of the indicator species. For example, in estimating a terrestrial mammal's exposure to substances in the environment, exposures resulting from the consumption of water and food (other animals or plants, depending on dietary habits), the incidental ingestion of soil, and (as appropriate) inhalation will be considered.

For terrestrial animals and birds, the measurement of exposure will be the estimated systemic dose, expressed in units of milligrams of the substance per kilogram body weight per day (mg/kg/day). When multiple pathways of exposure are considered, the total dose will be obtained by estimating the doses from the individual pathways and adding these doses together. Typical values for physiologic parameters (e.g., daily food and water consumption, body weight) will be used in the calculation of

systemic dose for each of the indicator species. For most terrestrial animals and birds, it is highly unlikely that either individuals of a species or entire populations of that species are exposed exclusively to contaminated media. To develop more realistic estimates of exposure, reasonable assumptions will be made, as appropriate, about the percent of each media containing the substance of concern to which an indicator species may be exposed.

For some species, the assessment of the potential of the substances of concern to affect the indicator species will consist of an evaluation of ambient environmental concentrations, e.g., soil concentrations for plants and water concentrations for fish, especially for radionuclides.

Because of limitations in available data, it is anticipated that not all pathways of exposure can be evaluated quantitatively. To the extent possible, qualitative evaluations of exposure to substances from the site will be developed where data are insufficient to estimate exposures quantitatively.

6.7.6 Risk Characterization

In the final step of the environmental risk assessment, the criterion dose (or concentration) for each of the indicator species, determined from a review of the toxicological or

radioecological data, will be compared to the estimated exposure level (i.e., estimated systemic dose or ambient concentration) for that particular species. The ratio of the criterion dose (or concentration) to the estimated exposure level is called the margin of safety (MOS). As the MOS is defined, the smaller the value of the ratio, the larger the potential risk. While some level of environmental risk may be associated with any exposure to a substance, risks posed by exposure to a substance with an MOS of one or greater will be considered not to be of significant environmental concern. MOS values less than one will suggest some concern for environmental impairment under the assumed conditions of exposure.

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7. INVESTIGATION ANALYSIS AND REPORT

All data acquired in the Quadrant II RFI will be analyzed and integrated to refine the characterization of the environmental setting, and to define the extent and rate of contaminant migration. The data will be reviewed in accordance with the quality assurance and data management plans presented in the RFI General Plan and any additional quality assurance guidelines presented in the Quadrant I and II RFI Work Plans. Throughout the investigation, data will be interpreted as it is acquired to ensure that the objectives of the investigation (as enumerated in Section 1.2 of this Work Plan) are being met.

In addition, the results of the investigation will be incorporated into a discussion of standards for protection of human health and the environment. With respect to potential cleanup technologies, this discussion will consider whether to support the use of background levels, of Maximum Concentration Limits (MCL's), or Alternate Concentration Limits (ACL's).

8. BENCH-SCALE STUDIES

A series of bench-scale tests will be performed as part of the Quadrant I RFI to determine the attenuation capacity of geologic units present in the subsurface of PORTS and to ascertain the effect of microbial degradation of known contaminants. Results of these studies will be used to predict contaminant transport and to evaluate various remedial measures. Because the geologic units are relatively homogeneous at PORTS, the bench-scale tests performed in the Quadrant I RFI will have site-wide applicability and need not be repeated during the Quadrant II investigation.

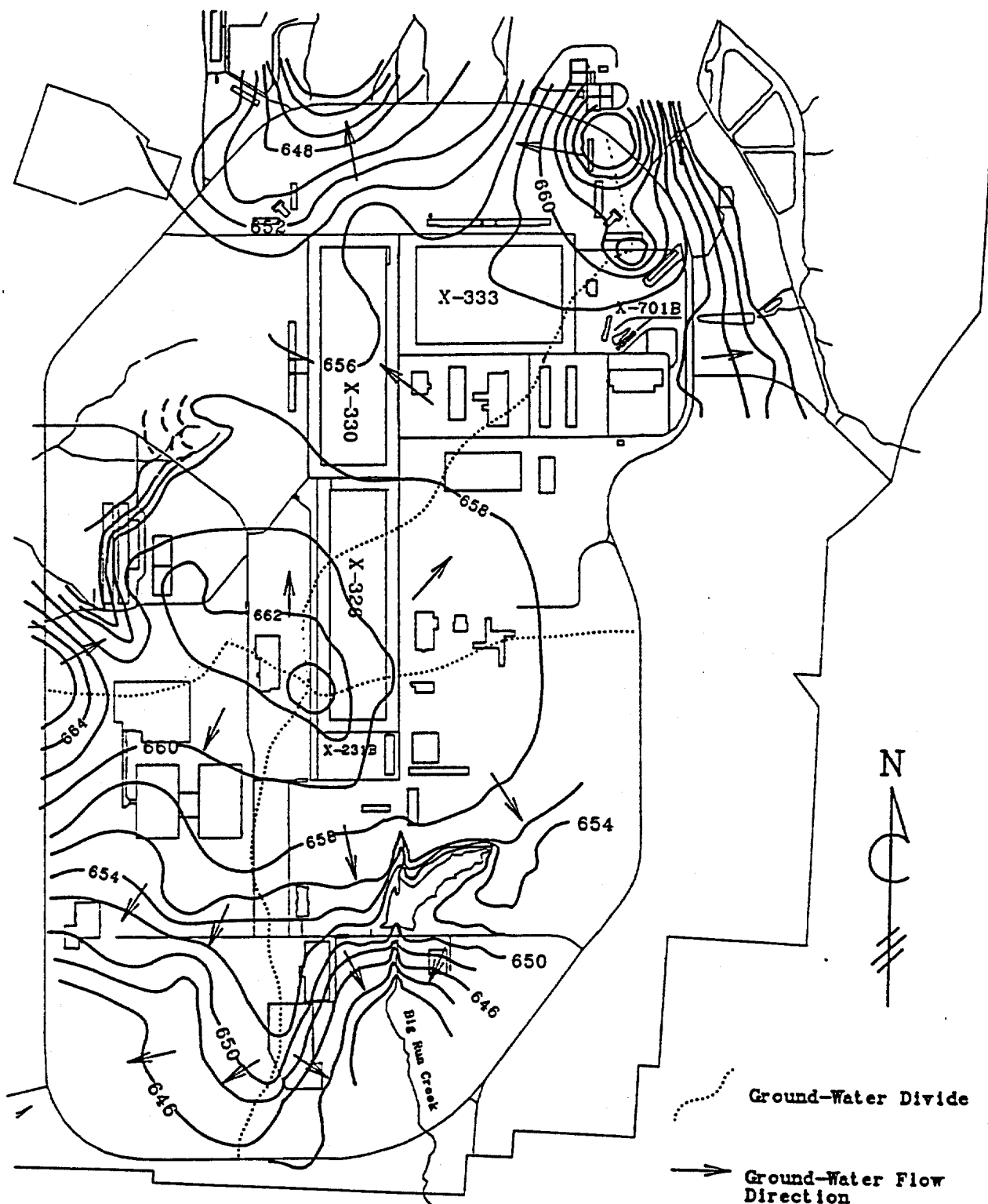
9. REPORTING REQUIREMENTS

The RFI General Plan was approved by OEPA in April 1989. The Quadrant I RFI Work Plan, Quadrant I Description of Current Conditions, and the Pre-Investigation Evaluation of Corrective Measures Technologies were submitted to OEPA for review in May 1989. These documents are still under review as of October 1989. MMES received OEPA's Comments on the Quadrant I RFI Work Plan on October 6.

During the Quadrant II investigation, a progress report will be submitted to OEPA and USEPA every month. Each Monthly Progress Report will include a brief summary of progress, results, problems encountered, changes to the work plan, contacts with the public sector, estimates of the percentage of work completed, and projections of work to be done in the next month. Following completion of the investigation, a final Quadrant II RFI Report will be submitted for review.

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SCALE 1:1500





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PREPARED
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Figure 4.2 Potentiometric Surface of the Gallia
(Quadrant II).

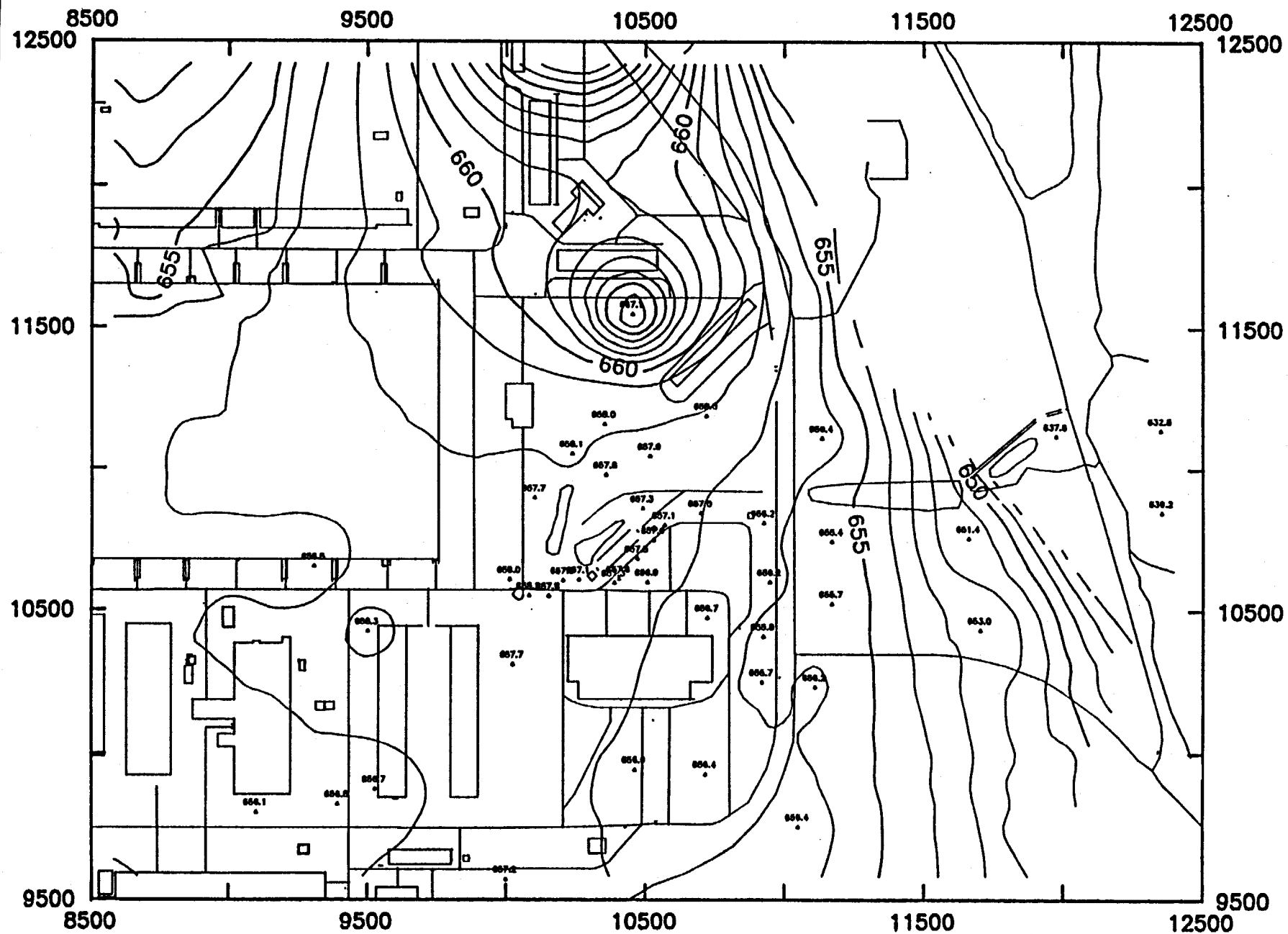


Figure 4.3 Potentiometric Surface of the Berea (Quadrant II).

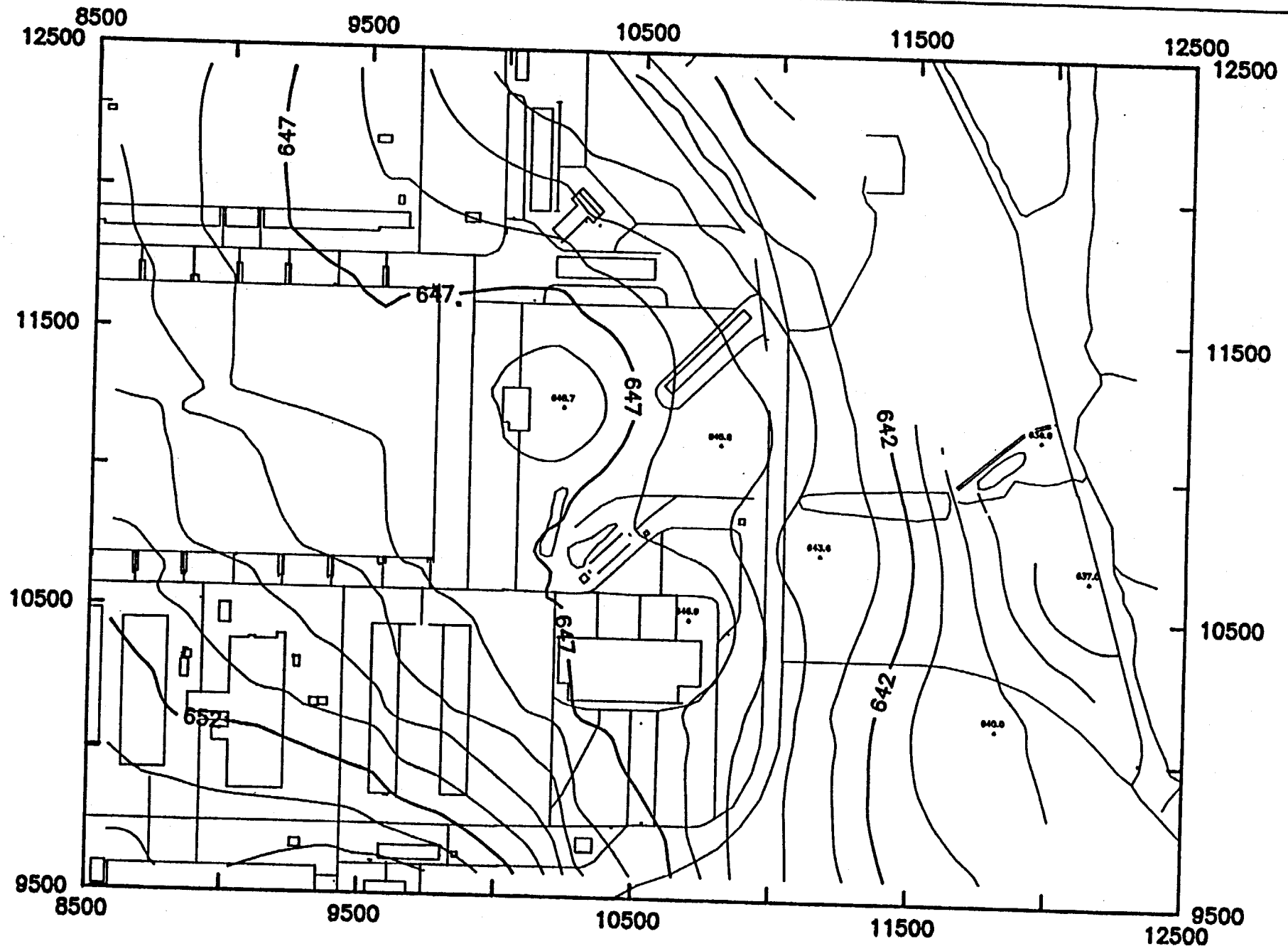
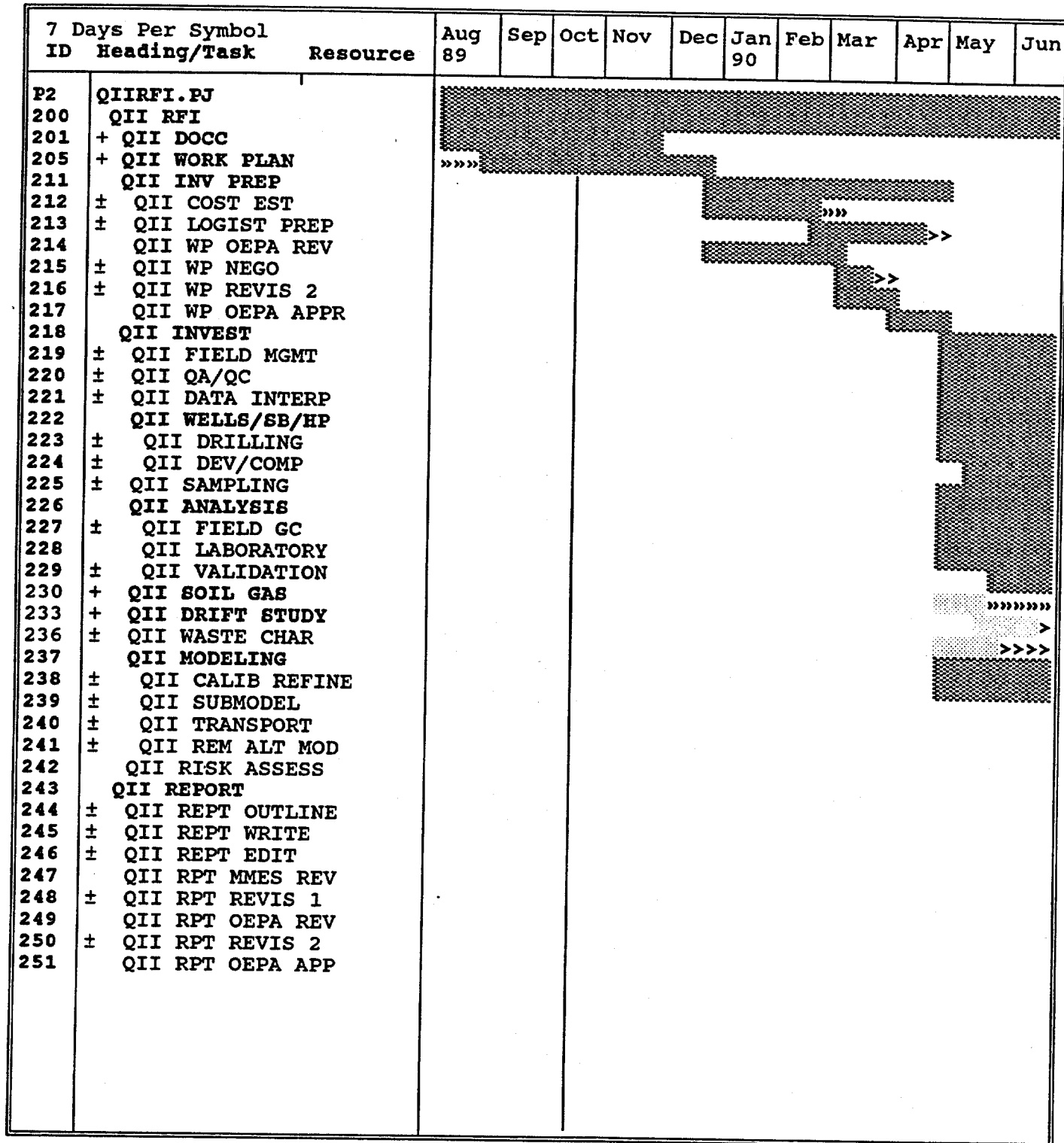


Figure 4.4 Tentative Schedule of Investigation Activities.



Non Critical m Milestone >>>> Float/Delay — Interrupt
 Critical M Critical MS >>> Free Float

Figure 4.4 (continued) Tentative Schedule of Investigation Activities.

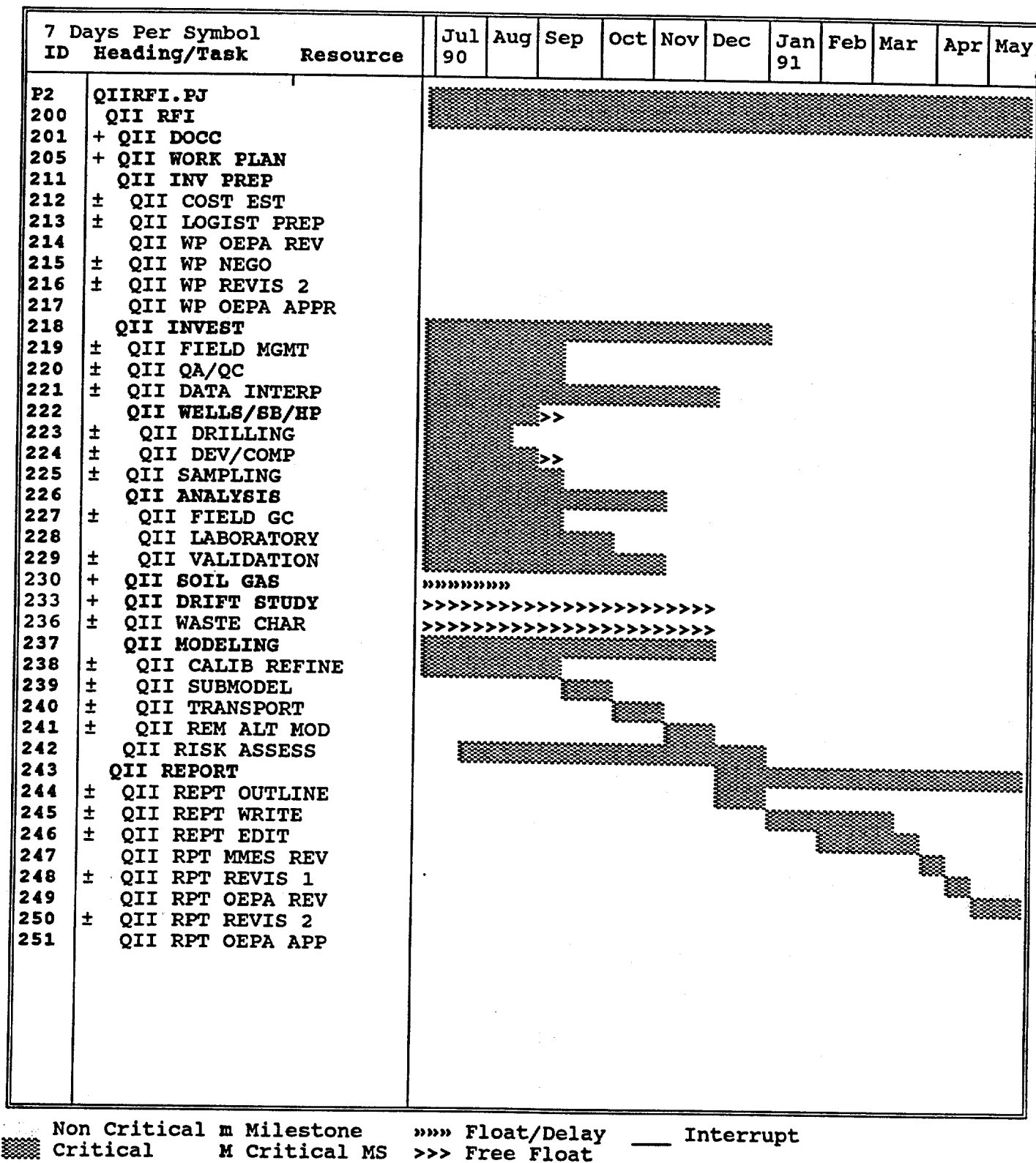




Figure 4.4 (continued) Tentative Schedule of Investigation Activities.

7 Days Per Symbol			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
ID	Heading/Task	Resource	91							92			
P2	QIIRFI.PJ												
200	QII RFI												
201	+ QII DOCC												
205	+ QII WORK PLAN												
211	QII INV PREP												
212	± QII COST EST												
213	± QII LOGIST PREP												
214	QII WP OEPA REV												
215	± QII WP NEGO												
216	± QII WP REVIS 2												
217	QII WP OEPA APPR												
218	QII INVEST												
219	± QII FIELD MGMT												
220	± QII QA/QC												
221	± QII DATA INTERP												
222	QII WELLS/SB/HP												
223	± QII DRILLING												
224	± QII DEV/COMP												
225	± QII SAMPLING												
226	QII ANALYSIS												
227	± QII FIELD GC												
228	QII LABORATORY												
229	± QII VALIDATION												
230	+ QII SOIL GAS												
233	+ QII DRIFT STUDY												
236	± QII WASTE CHAR												
237	QII MODELING												
238	± QII CALIB REFINE												
239	± QII SUBMODEL												
240	± QII TRANSPORT												
241	± QII REM ALT MOD												
242	QII RISK ASSESS												
243	QII REPORT												
244	± QII REPT OUTLINE												
245	± QII REPT WRITE												
246	± QII REPT EDIT												
247	QII RPT MMES REV												
248	± QII RPT REVIS 1												
249	QII RPT OEPA REV												
250	± QII RPT REVIS 2												
251	QII RPT OEPA APP												

 Non Critical m Milestone >>>> Float/Delay — Interrupt
 Critical M Critical MS >>> Free Float

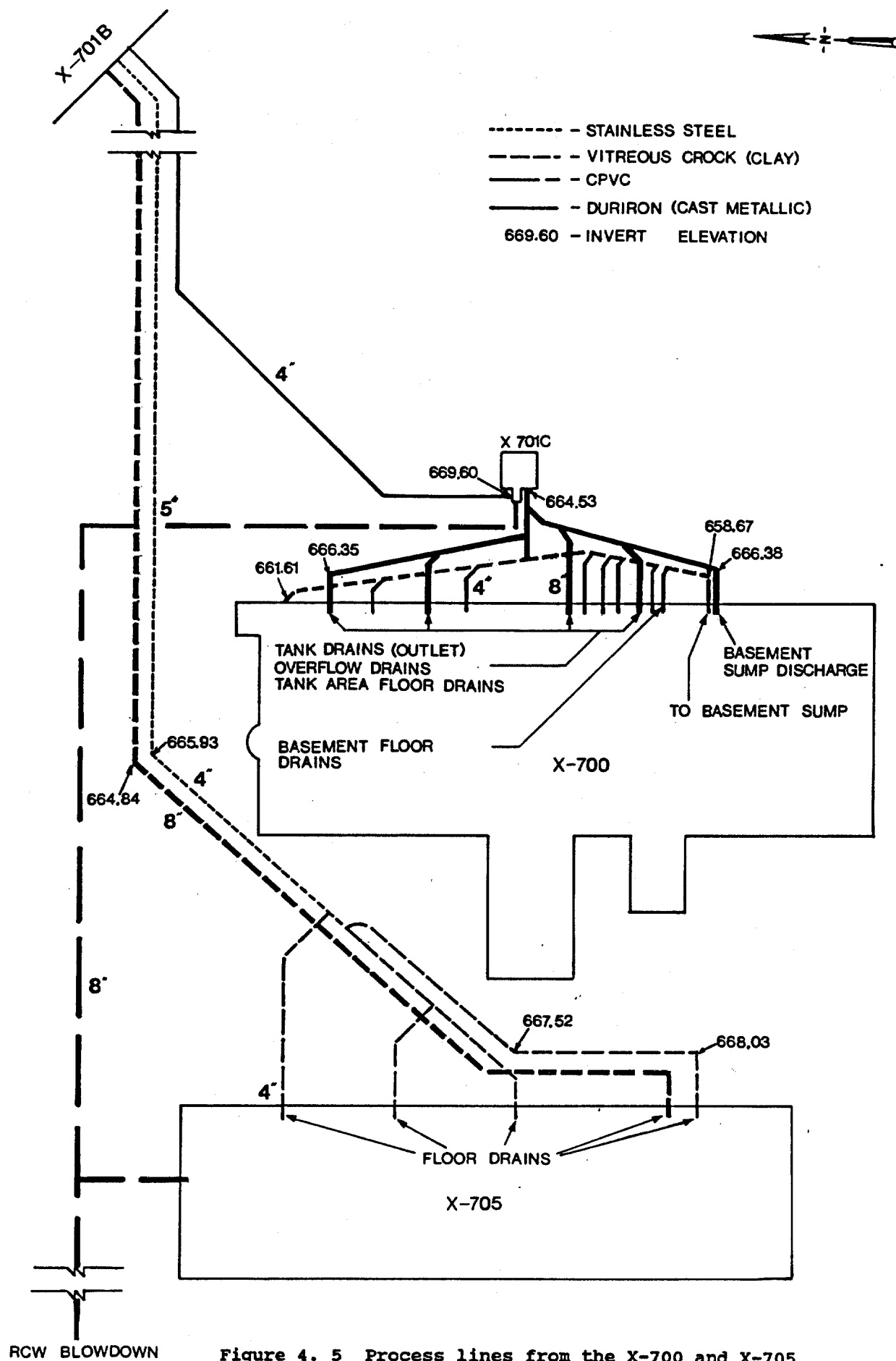


Figure 4. 5 Process lines from the X-700 and X-705 Buildings to the X-701B Holding Pond (line diameters given in inches).

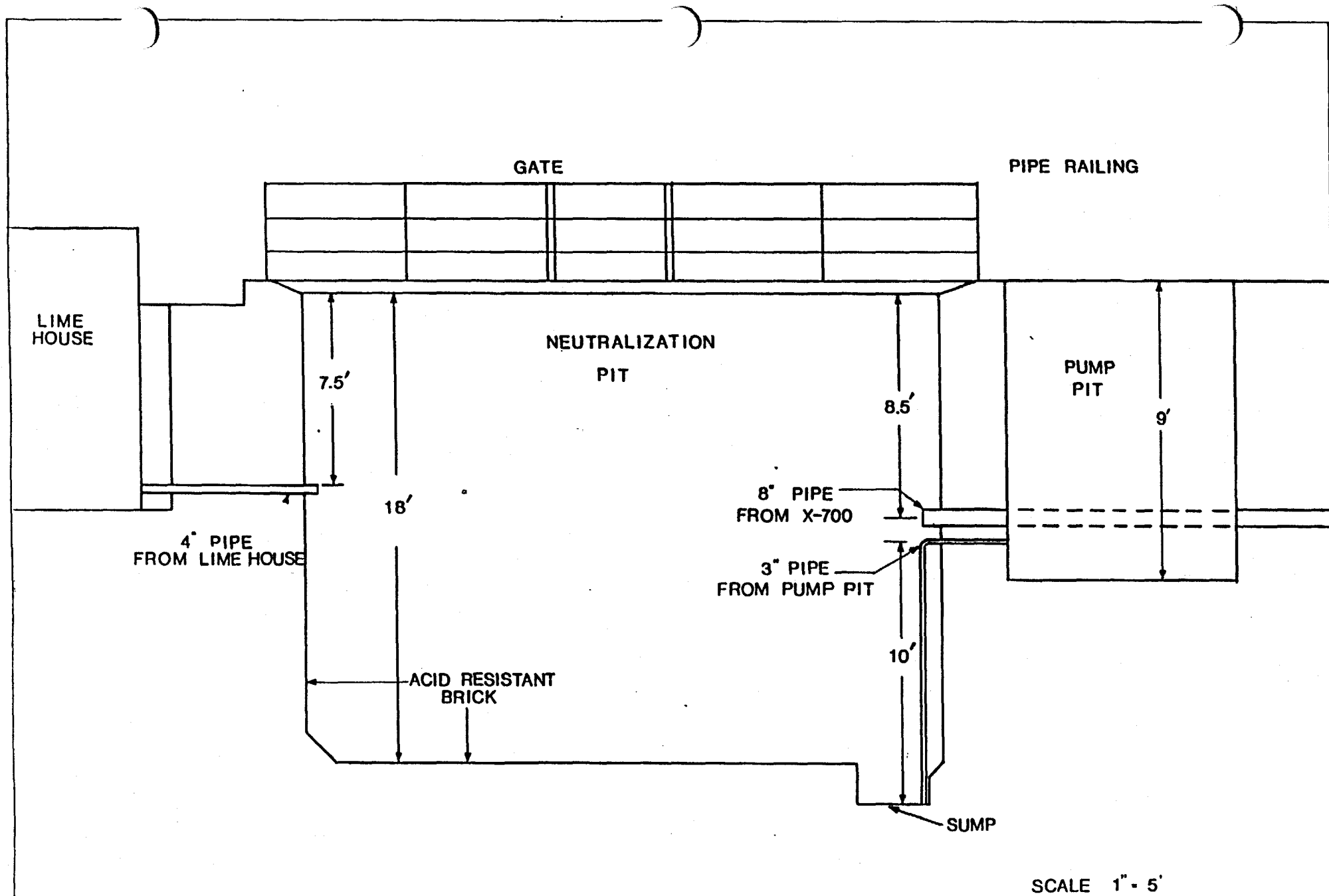


Figure 4.6 Schematic East-West Cross Section through X-701C Neutralization Pit.

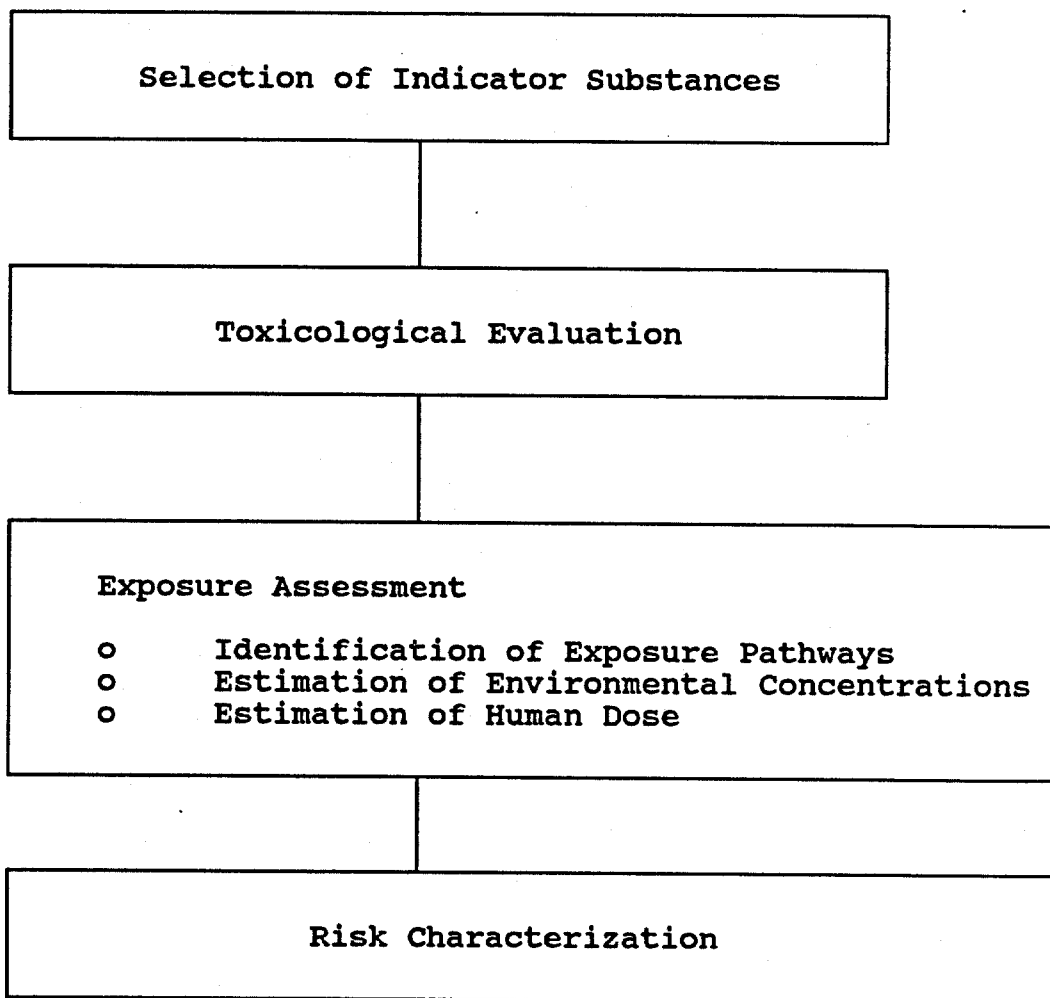


Figure 6.1

Public Health Risk Assessment Methodology

TABLE 4.1

CHEMICAL PARAMETERS OF RCW PRIOR TO 1982*
(ppm)

Component	RCW	
	Av.	Peak
pH	6.1	6.5
Total Hardness as CaCO ₃	455	670
Calcium (CaCO ₃)	122	215
Magnesium (CaCO ₃)	333	455
Total phosphates (PO ₄)	2.1	2.7
Chromates	20	25
Chromium	9	11
Zinc	1.8	2.5
Copper	0.07	0.15
Iron	0.2	0.7
Chloride	81	105
Sulfate	345	475
Free Chlorine residual	0.4	0.8
Silica	29	50
Sodium pentachlorophenate	0.7	17

*Sodium Pentachlorophenate was replaced by
cupric arsenate 1982.

Table 4.2

POTENTIAL CONTAMINANTS USED AT FACILITIES IN QURADRANT II

X-700 Chemical Cleaning Facility	X-705 Decontamination Building	X-720 Maintenance Building
<p>chromic acid nitric acid TCE sodium sulfate Wyandotte 1268 (sodium hydroxide) silver uranium chloroethene</p>	<p><u>Decontamination Facilities</u></p> <p>uranium isoproponal Stoddard's solvent nitrogen oxides ammonium carbonate sodium bifuoride Wyandotte 1189 (sodium acid sulfate) Wyandotte 1268 (sodium hydroxide) trichloroethane 1,1,1-trichloroethane aluminum tri-hydrate aluminum nitrate caustic soda hydrochloric acid sodium dichromate tributyl phosphate nitric acid undecane decane nonane</p> <p><u>Laundry Facilities</u></p> <p>bleach detergent alkali ammonium bifuoride softener uranium (minor)</p>	<p>uranium methylethylketone Stoddard's solvent mineral spirits lacquer thinner cyanide plating solution (hydrochloric, sulfuric, and nitric acids with cyanide salts) TCE chloroethene mercury aqueous ammonium carbonate strychnine sodium cyanide lubricants and oils</p>

TABLE 4.3

DOCUMENTED RELEASES TO THE SANITARY
SEWER SYSTEM IN QUADRANT II

UNIT	AREA	WASTE	AMOUNT
X-700	X-ray development	silver nitrate	unknown
X-705	Laundry facility	Alkali, sodium bi-fluoride, minor amounts of uranium	14,500 gal/yr
	Process laboratory and other floor drains	Dilute chemical solutions and uranium contaminated solutions	4,800 gal/yr
X-720	Instrument cleaning and plating	Hydrochloric, nitric and sulfuric acids, cyanide salts	250 gal/yr

TABLE.4-3:QIIWP

TABLE 4.4

CONTRIBUTIONS TO STORM SEWERS D AND E

FLOOR DRAINS	SURFACE RUNOFF
Storm Sewer D Quadrant III X-326 Process Bldg. Diesel Air Plant X-330(SE) Process Bldg. Filter Room Drains X-330 Process Bldg., Air and Diesel Air Plants,* Nitrogen Plant** X-330 Process Bldg. cooling water Quadrant IV X-333(S) Process Bldg. Filter Room Drains X-333 Process Bldg. cooling water X-333 Process Bldg. Air Plant	Quadrant II X-700 Chemical Cleaning Facility X-705 Decontamination Bldg. Quadrant III X-326 Process Bldg. X-330 Process Bldg. Quadrant IV X-333 Process Bldg.
Storm Sewer E Quadrant II X-705 Decontamination Bldg. Refrigeration Unit "E" X-720 Maintenance Bldg. cleaning floor Quadrant III X-326(NE) Process Bldg. Filter Room Drains	Quadrant I X-103 Auxiliary Office Bldg. X-741 Oil Drum Storage Facility X-742 Gas Cylinder Storage Facility X-743 Lumber Storage Facility Quadrant II X-720 Maintenance Bldg. X-744G, H, and J Bulk Storage Areas X-747A, B, C, D and E Material Storage Yards

* The Air and Diesel Air Plants provide compressed air. The diesel air plants are used as emergency backups.

** The Nitrogen Plant Facility is designed to produce 100 (scf) of nitrogen per minute. The nitrogen is used for purging various UF₆ processing systems and as a low temperature refrigerant.

TABLE.4-4:QIIWP

TABLE 6.1 EXPOSURE ASSESSMENT ASSUMPTIONS (a)

	ADULT MALE	ADULT FEMALE	15 YR OLD	9 YR OLD	4 YR OLD	REFERENCE
DAYS PER LIFETIME (lifetime-days)	27375	28470	27375	27375	27375	USEPA 1989a
YEARS OF EXPOSURE	57	60	6	6	4	USEPA 1989a
BODY WEIGHT (kg)	70	65	56	31	16	USEPA 1989a
BREATHING RATE (m ³ /hr)	0.833(b)	0.833(b)	0.875	0.625	0.333	Adult-USEPA 1989 Kids-ICRP 1984
TOTAL BODY SURFACE AREA (cm ²)	18000	16000	15000	9000	7000	ICRP 1984
SURFACE AREA OF						
Lower Limbs (cm ²) (36%)	6480	5760	5400	3240	2520	ICRP 1984
Hands (cm ²) (4%)	720	640	600	360	280	ICRP 1984
Upper Limbs (cm ²) (18%)	3240	2880	2700	1620	1260	ICRP 1984
Torso (cm ²) (36%)	6480	5760	5400	3240	2520	ICRP 1984
Head and Neck (cm ²) (9%)	1620	1440	1350	810	630	ICRP 1984
Perineum (cm ²) (1%)	180	160	150	90	70	ICRP 1984
<hr/>						
SCENARIO A1: INGESTION OF WATER						
Amount ingested (l/day)	1.4(c)	1.4(c)	1.4(c)	1	1	USEPA 1989a
Fraction of time water contaminated	100%	100%	100%	100%	100%	ERMA
SCENARIO A3: DERMAL - WATER, PLAYING BY CREEK						
Hours of contact (per day of contact)	1	1	1	1	1	ERMA
Days by creek per year	30	30	90	90	90	ERMA
Surface area of contact (cm ²)	2970	2640	2475	3105	2415	ERMA
AM,AF,FIF:1/2 head&neck + 2/3 Upper limbs						
FOUR,NINE:1/2 head&neck + 2/3 Upper limbs + 1/2 Lower limbs						
SCENARIO B1: INGESTION OF SOIL						
Amount ingested (kg)	0.0001	0.0001	0.0001	0.0001	0.0002	USEPA 1989b
Fraction of time soil contaminated	100%	100%	100%	100%	100%	ERMA
SCENARIO B2: DERMAL - SOIL - OUTDOORS, Gardening or playing						
Number contacts						

TABLE 6.1 EXPOSURE ASSESSMENT ASSUMPTIONS (a)

	ADULT MALE	ADULT FEMALE	15 YR OLD	9 YR OLD	4 YR OLD	REFERENCE
Days exposed per week (e.g. adults gardening, kids playing)	2	2	4	4	4	ERMA
Weeks exposed per year	24	24	24	24	24	ERMA
Amount of soil per surface area of contact (kg/cm ²)	0.0000005	0.0000005	0.0000005	0.0000005	0.0000005	LEPOW 1975
Surface area of contact	2970	2640	2475	3105	2415	ERMA
for AM,AF,FIF = Face + 2/3 Upper Limbs						
for FOUR,NINE = Face + 2/3 Upper Limbs + 1/2 Lower Limbs						
Fraction of time soil contaminated	100%	100%	100%	100%	100%	ERMA
SCENARIO C1: INHALATION - VAPORS						
Contact time (hr/day)	17(d)	17(d)	17(d)	17(d)	17(d)	USEPA 1989a
SCENARIO D2: INGESTION OF FOOD (BEEF)						
Amount ingested (kg/day)	0.044(e)	0.044(e)	---	---	---	USEPA 1989a
Fraction of time beef contaminated	100%	100%	100%	100%	100%	ERMA
SCENARIO D5: INGESTION OF FOOD (FISH, FRESHWATER)						
Amount ingested (kg/day)	(f)	(f)	(f)	(f)	(f)	
Fraction of time freshwater fish contaminated	100%	100%	100%	100%	100%	ERMA
SCENARIO D8: INGESTION OF FOOD (MILK AND OTHER DAIRY PRODUCTS)						
Amount ingested (kg)	0.16(g)	0.16(g)	---	---	---	USEPA 1989a
Fraction of time milk contaminated	100%	100%	100%	100%	100%	ERMA

(a) Based on population mobility data, USEPA (1989a) recommends that 9 and 30 years be used to represent the average length of residence time and reasonable upper bound of residence time, respectively. Length of residence for rural populations may be longer.

(b) For reasonable worst case exposure conditions, USEPA (1989a) recommends an adult breathing rate of 30 m³/day or 1.25 m³/hr.

(c) USEPA (1989a) recommends 2 liters/day as a reasonable worst-case drinking water consumption rate for adults.

(d) USEPA (1989a) estimates that the average adult spends about 70% of the time at home. The amount of time spent at home will be assumed to be 100% in the reasonable worst case.

TABLE 6.1 EXPOSURE ASSESSMENT ASSUMPTIONS (a)

- (e) USEPA (1989a) recommends 0.075 kg/day as a reasonable worst case consumption rate for homegrown beef.
 - (f) USEPA (1989a) does not recommend fish consumption rates for a small water body. For large water bodies, USEPA recommends fish consumption rates for recreational fishermen of 30 g/day (50th percentile) and 140 g/day (90th percentile). Fish consumption rates for the Portsmouth site will be based on site-specific considerations.
 - (g) USEPA (1989a) recommends 0.30 kg/day as a reasonable worst case consumption rate for homegrown dairy products.
-

REFERENCES TO TABLE 6.1

Environmental Protection Agency (EPA). 1989a. Exposure factors handbook. Exposure Assessment Group, Office of Health and Environmental Assessment. EPA/600/8-89/043.

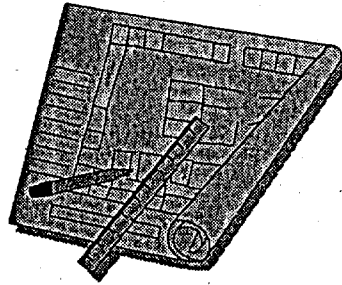
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APPENDIX A
PLATES I - V



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APPENDIX B

**STANDARD METHODOLOGY FOR
PREPARATION OF SOILS FOR FIELD-GC ANALYSIS**

STANDARD METHODOLOGY FOR PREPARATION OF SOIL SAMPLES FOR FIELD-GC ANALYSIS

Sample Preparation

Approximately twenty grams of soil will be transferred to a 40 ml VOA vial equipped with a screw cap and Teflon septum. Approximately twenty to thirty ml of laboratory-grade distilled water will then be added to the soil sample and agitated to create a slurry. The slurry sample may then be refrigerated for up to two days before analysis. In storage, all vials will be inverted to prevent the loss of VOC's through the Teflon septum. The exact details of sample preparation will be determined according to conditions encountered in the field and fully documented.

Immediately prior to analysis, the slurry sample will be brought to a constant temperature and agitated to produce a homogenous sample. A head-space sample of known volume will then be withdrawn from the slurry sample vial and analyzed with the Photovac 10S50. The resulting chromatogram will be labelled with the injection volume and time, a sample number and the retention times and peak areas. The retention times will be compared to standard chromatograms to identify VOC's in the sample. Response factors calculated from standard chromatograms will then be used to convert peak areas into sample concentrations.

Development of Standard Curve

In order to quantify the results of field-GC analyses, standards with known concentrations must be analyzed periodically. A standard curve will be generated by analyzing known concentrations of TCE, DCE, and PCE in solution. Three standards in the range from 10 ppb to 1 ppm will be prepared. The three-point standard curve will be generated weekly and a single standard curve will be generated weekly and a single standard from the curve

will be analyzed every fifth sample. The three-point curves will be used to track the reproducibility of field-GC analyses over time. All sample results will be quantified using the nearest standard runs.

In addition to the standard analyses, one duplicate sample will be analyzed per every tenth analysis. Instrument and syringe blanks will also be performed on a regular basis to ensure that contamination of syringes or the GC-column has not occurred.

STANDARD METHODOLOGY FOR FIELD DETERMINATION OF SOIL pH

1.0 SCOPE AND APPLICATION

1.1 Method 9045 is an electrometric procedure which has been approved for measuring pH in calcareous and noncalcareous soils.

2.0 SUMMARY OF METHOD

2.1 The soil sample is mixed either with Type II water or with a calcium chloride solution (see Section 5.0), depending on whether the soil is considered calcareous or noncalcareous. The pH of the solution is then measured with a pH meter.

3.0 INTERFERENCES

3.1 Samples with very low or very high pH may give incorrect readings on the meter. For samples with a true pH of >10 , the measured pH may be incorrectly low. This error can be minimized by using a low-sodium-error electrode. Strong acid solutions, with a true pH of <1 , may give incorrectly high pH measurements.

3.2 Temperature fluctuations will cause measurement errors.

3.3 Errors will occur when the electrodes become coated. If an electrode becomes coated with an oily material that will not rinse free, the electrode can either (1) be cleaned with an ultrasonic bath, or (2) be washed with detergent, rinsed several times with water, placed in 1:10 HCl so that the lower third of the electrode is submerged, and then thoroughly rinsed with water.

7.2.3 Adjust the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Insert the electrodes into the sample solution in this manner. For combination electrodes, immerse just below the suspension.

7.2.4 If the sample temperature differs by more than 2°C from the buffer solution, the measured pH values must be corrected.

7.2.5 Report the results as "soil pH measured in water."

7.3 Sample preparation and pH measurement of calcareous soils:

7.3.1 To 10 g of soil in a 50-mL beaker, add 20 mL of 0.01 M CaCl_2 (Step 5.5) solution and stir the suspension several times during the next 30 min.

7.3.2 Let the soil suspension stand for about 30 min to allow most of the suspended clay to settle out from the suspension.

7.3.3 Adjust the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed well into the partly settled suspension and the calomel electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Insert the electrode into the sample solution in this manner.

7.3.4 If the sample temperature differs by more than 2°C from the buffer solution, the measured pH values must be corrected.

7.3.5 Report the results as "soil pH measured in 0.01 M CaCl₂".

8.0 QUALITY CONTROL

8.1 Duplicate samples and check standards should be analyzed routinely.

8.2 Electrodes must be thoroughly rinsed between samples.

9.0 REFERENCE

Test Methods for Evaluating Solid Waste Physical/Chemical Parameters, U.S. EPA, SW-846, Volume 1C, 1986, Third Revision.

APPENDIX C
QUADRANT II RFI
HEALTH AND SAFETY PLAN
SITE-SPECIFIC PROVISIONS

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1.0 INTRODUCTION

The following site-specific health and safety provisions have been developed for use during the Quadrant II RFI field investigations to be performed at the Portsmouth Gaseous Diffusion Plant (PORTS). This document addresses only those items specified under 29 CFR 1910.120(i) (2)(i) Interim Rule which are not included in the Generic Health and Safety Plan (GHASP) as outlined therein. References to pertinent sections of the GHASP are provided where general health & safety provisions are to be employed during Quadrant II RFI activities.

2.0 HEALTH & SAFETY PLAN ENFORCEMENT

The following personnel will be responsible for implementation and enforcement of the health and safety provisions outlined herein.

2.1 Project Manager

The G&M project manager is ultimately responsible for ensuring that all project participants abide by the requirements set forth in this plan. The health and safety coordinator will report directly to the project manager.

- Quadrant II RFI Project Manager: Robert King

2.2 Health & Safety Coordinator

The G&M health and safety coordinator (HSC) will be responsible for providing technical coordination of the health and safety program. The HSC will act in an advisory capacity to the Health and Safety Officer (HSO). Liaison with officers and representatives of EPA on matters relating to health and safety will be handled by the HSC or the HSO.

- Quadrant II RFI Health and Safety Coordinator: Timothy Ratvasky.

2.3 Health & Safety Officer

The G&M Health and Safety Officer (HSO) will be responsible for field implementation and enforcement of this Health and Safety Plan. The HSO must be familiar with OSHA construction and general industry standards as well as health and safety requirements specific to PORTS. The HSO will provide the on-site inspector with details concerning this safety and health program. He will also provide the on-site inspector with the HASP-related documentation which must be available at all work sites. This documentation includes the following:

- A copy of the physicians written opinion (see Section 6 of this HASP, "Medical Surveillance") for each employee;
- A copy of the training record which documents that each employee has completed the necessary training to accomplish the job (see Section 4 of the HASP, "Employee Training Requirements" and is trained in the use of respiratory protection equipment;
- Documentation of the fit-testing program for respiratory protection equipment (meeting the requirements of OSHA 1910.134 and the American National Standards Institute (ANSI Z88.2-1980)
- Task-specific (e.g., drilling, drumming waste, etc.) air-monitoring records;
- Site safety inspection records;
- A copy of this HASP and the Quadrant II RFI Work Plan.
- Assurance that operators possess current licenses/certificates to operate motorized equipment.
- Quadrant II RFI Health and Safety Officer: Alice Waldhauer

- Health and Safety Officer Designee (alternate): David Frederick

2.4 Corporate Health and Safety Officer

Disputes over health and safety issues will be resolved by the G&M corporate health and safety officer prior to submitting a modified HASP to OEPA and USEPA for review. The corporate health and safety officer, OEPA and USEPA shall also be kept informed of all changes made to this HASP.

- G&M Corporate Health & Safety Officer: Andrew Barber

3.0 SITE-SPECIFIC HAZARD EVALUATION

Potentially hazardous substances which may be encountered during Quadrant II RFI field activities are presented by category on Table 3.1. This list of potentially hazardous compounds was compiled from existing facility records, results of past hydrogeologic investigations, and communication with MMES personnel.

The toxicological, human health, and safety information for these compounds are summarized in Table 3.2. Unit locations at which these substances might be encountered are presented on Table 3.3.

Field activities to be performed during the Quadrant II RFI consist of hand-operated and motorized, truck-mounted auger drilling with soil sampling, monitoring-well installation, surface-water and ground-water sampling, basin sediment sampling, storage tank sampling, stream sediment sampling and test pit investigations. Detailed descriptions of these activities have been presented in Section 4.6 of the Quadrant II RFI Work Plan (hereafter referred to as the Plan). Activities to be performed at each MMES Unit to be covered during Quadrant II RFI activities are summarized on Table 3.4.

TABLE 3.1

POTENTIALLY HAZARDOUS SUBSTANCES
WHICH MAY BE ENCOUNTERED DURING
QUADRANT II RFI ACTIVITIES

CONTAMINANT CATEGORY	CONTAMINANT	ANTICIPATED CONCENTRATION OF CONTAMINANTS	MATRIX(1)	POTENTIAL(2) EXPOSURE ROUTE
Recirculating Cooling Water (RCW)	Pentachlorophenol	Unknown	S	C
	Cupric Arsenate	Unknown	D,S	I,In,C
	Dichromates	Unknown	D,S	I,In,C
	Chromium	Unknown	G	C,In
Organic Chemicals	1,1,2-trichloroethane	Unknown	V,G,S	I,In,C
	Trichloroethylene	400-600 ppb (soil & water) (X-230J7)	V,G,S	I,In,C
		Unknown		
	1,1-dichloroethylene	Unknown	V,G,S	I,In,C
	1,1-dichloroethane	Unknown	V,G,S	I,In,C
	1,1,1-trichloroethane	<5 to separate phase (X-701c)	V,G,S	I,In,C
	Trans-1,2-dichloro- ethylene	Unknown	V,G,S	I,In,C
	Methylene Chloride	Unknown	V,G,S	I,In,C
	Chloroform	Unknown	V,G,S	I,In,C
	Carbon Tetrachloride	Unknown	V,G,S	I,In,C
	Benzene (fuel)	Unknown	V,G,S	I,In,C
	Toluene (fuel)	Unknown	V,G,S	I,In,C
	Xylene (fuel)	Unknown	V,G,S	I,In,C
	Ethylbenzene (fuel)	Unknown	V,G,S	I,In,C
	Freon-113	Unknown	V,G,S	I,In,C
	Freon-114	Unknown	S,G	I,In
	Stoddard Solvent	Unknown	S,G	I,In
	Methyl ethyl ketone	Unknown	S,G	I,In
	Mineral Spirits	Unknown	S,G	I,In,C
	Isopropanol	Unknown	S,G	I,In
	Kerosene	Unknown	S,G	I,In
	Cyanide	Unknown	S,G,V	I,In,C

(1)

D = Cooling Water Drift (liquid aerosol)
S = Soil
V = Vapor Phase (atmosphere)
G = Ground Water
F = Fuel Material
P = Process Discharge

(2)

I = Inhalation
In = Ingestion
C = Contact/Skin Absorption

TABLE 3.1 (cont.)
POTENTIALLY HAZARDOUS SUBSTANCES
WHICH MAY BE ENCOUNTERED DURING
QUADRANT II RFI ACTIVITIES

CONTAMINANT CATEGORY	CONTAMINANT	ANTICIPATED CONCENTRATION OF CONTAMINANTS	MATRIX(1)	POTENTIAL(2) EXPOSURE ROUTE
Inorganic Chemicals	Lead	Unknown	S,G	In
	Barium	Unknown	S,G	In
	Nickel	Unknown	S,G	In
	Manganese	Unknown	S,G	In
	Mercury	Unknown	P,S,G	I,In,C
	Sulfuric Acid	Unknown	P,S,G	I,In,C
	Nitric Acid	Unknown	P,S,G	I,In,C
	Chromic Acid	Unknown	P,S,G	I,In,C
	Sodium Hydroxide	Unknown	P,S,G	I,C
Strychnine		Unknown	P,S,G	I,In
Dioxins		0.15-4.9 ug/L	S	C,In,I
PCBs	Arochlor (undefined)	<1-62 ppm (soil)	S	C
Radionuclides	Uranium	<1-220 ug/L (soil)	S,G,D	I,In,C
	Technetium-99	Unknown	S,G,D	I,In,C
	Thorium	Unknown	S,G,V	I,In,C
Asbestos		Unknown	F	I,In

(1)

D = Cooling Water Drift (liquid aerosol)
S = Soil
V = Vapor Phase (atmosphere)
G = Ground Water
F = Fill Material
P = Process Discharge

(2)

I = Inhalation
In = Ingestion
C = Contact/Skin Absorption

TABLE 3.2

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Arsenic (inorganic)

SYNONYMS:	Synonyms vary
PERMISSIBLE EXPOSURE LIMIT:	10 ug/m ³ (OSHA)
IDLH LEVEL:	N/A; carcinogen
ODOR THRESHOLD:	N/A; odor varies
PHYSICAL DESCRIPTION:	Properties vary with compound
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated, non- impervious clothing immediately Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Weakness, anorexia, hyperpigmentation, hyperkeratosis dermatitis, vomiting, severe gastrointestinal cramps, damage to circulatory system
FIRST AID:	Eye: Irrigate immediately (15 min.) Skin: Wash exposed skin promptly Ingestion: Medical attention
TARGET ORGANS:	
FLAMMABILITY:	Properties vary with compound

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Asbestos

SYNONYMS:	Chrysotile
PERMISSIBLE EXPOSURE LIMIT:	0.2 fibers/cm ³ > 5um, air 8 hour TWA (OSHA)
IDLH LEVEL:	N/A, carcinogen
ODOR THRESHOLD:	N/A
PHYSICAL DESCRIPTION:	Varies based upon application, flaxy fibers
PERSONNEL PROTECTION AND SANITATION:	Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 5 Wash: Daily Change: Daily Work Clothes Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion
SYMPTOMS:	Mild irritation to nose, throat, eyes: gastrointestinal, lung, and throat cancer; teratogen, mutagen, pneumoconiosis (asbestosis)
FIRST AID:	Eye: Irrigate immediately
TARGET ORGANS:	Lungs
FLAMMABILITY:	Not flammable

TABLE 3.2 (cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

	Barium
SYNONYMS:	Varies with compound
PERMISSIBLE EXPOSURE LIMIT:	0.5 mg/m ³ (OSHA)
IDLH LEVEL:	250 mg/m ³
ODOR THRESHOLD:	Odor varies
PHYSICAL DESCRIPTION:	Appearance varies
ROUTES OF ENTRY:	Inhalation, Ingestion
SYMPTOMS:	Upper respiratory tract irritation, muscle spasms, slow pulse, skin burns, eye irritation, hypokalemia
FIRST AID:	Eye: Irrigate immediately Skin: Flush affected skin immediately Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Heart, CNS, skin, eyes, respiratory system
FLAMMABILITY:	Varies with compound

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

	Benzene
SYNONYMS:	Benzol, Coal Tar Naptha
PERMISSIBLE EXPOSURE LIMIT:	1 ppm (OSHA)
IDLH LEVEL:	N/A; carcinogen
ODOR THRESHOLD:	1 ppm; aromatic odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated clothing immediately
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, nose, throat irritant; giddiness headache, nausea, staggering, anorexia, fatigue, bone marrow depression
FIRST AID:	Eye: Irrigate immediately Skin: Wash exposed skin immediately Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	
FLAMMABILITY:	Lower Explosive Limit: 1.3% Upper Explosive Limit: 7.1%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Carbon Tetrachloride

SYNONYMS:	Tetrachloromethane
PERMISSIBLE EXPOSURE LIMIT:	2 ppm (OSHA)
IDLH LEVEL:	N/A; carcinogen
ODOR THRESHOLD:	2-16 ppm; ether-like odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated, non- impervious clothing
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Nervous system depression, nausea, vomiting, skin irritation, liver & kidney damage, suspected carcinogen
FIRST AID:	Eye: Irrigate immediately Skin: Wash exposed skin immediately Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Lungs, liver, kidneys, eyes, CNS, skin
FLAMMABILITY:	Non-Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Chloroform

SYNONYMS:	Trichloromethane
PERMISSIBLE EXPOSURE LIMIT:	2 ppm (OSHA)
IDLH LEVEL:	Suspected carcinogen
ODOR THRESHOLD:	205 ppm; sweet odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Protective Clothing: Required; see Section 5 Remove: Any non-impervious contaminated clothing Provide: Eyewash station
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Dizziness, dullness, nausea, headache, fatigue, eye irritation, liver dysfunction
FIRST AID:	Eye: Irrigate immediately for 15 minutes Skin: Wash promptly after skin contact Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Eyes, central nervous system, liver
FLAMMABILITY:	Not Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Chromic Acid

SYNONYMS:	None
PERMISSIBLE EXPOSURE LIMIT:	1 mg/10m ³ ceiling (OSHA)
IDLH LEVEL:	N/A
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Properties and appearance may vary
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Gloves/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious clothing immediately Provide: Eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye damage, skin ulceration and dermatitis, nasal septum irritation and perforation, frontal headache, bronchitis, jaundice
FIRST AID:	Eye: Irrigate immediately (15+ minutes) Skin: Flush immediately Breath: Artificial respiration Ingestion: Seek immediate medical attention; drink water or milk
TARGET ORGANS:	Skin, eyes, respiratory system, liver, kidneys
FLAMMABILITY:	Not combustible, but reactive

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Chromium VI

SYNONYMS:	Varies, based upon compound
PERMISSIBLE EXPOSURE LIMIT:	0.1 mg/m ³ (OSHA) ceiling
IDLH LEVEL:	N/A; carcinogen
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Varies, based upon compound
PERSONNEL PROTECTION AND SANITATION:	Change: Contaminated clothing promptly Provide: Eyewash station
ROUTES OF ENTRY:	Inhalation, Ingestion
SYMPTOMS:	Fibrosis of lungs, carcinogen, necrosis of kidney
FIRST AID:	Eye: Irrigate immediately Skin: Wash skin after contact Breath: Artificial respiration Swallow: Get medical attention
TARGET ORGANS:	Respiratory system, kidneys, gastrointestinal tract
FLAMMABILITY:	Not Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Dibenzofurans

SYNONYMS:	Tetra-, Penta-, Hexa-, Hepta-, and Octa-chlorodibenzofurans
PERMISSIBLE EXPOSURE LIMIT:	None established by OSHA, NIOSH, ACGIH
IDLH LEVEL:	N/A
ODOR THRESHOLD:	Data not available
PHYSICAL DESCRIPTION:	Residues of combustion; in ash and as contaminants in phenolic compounds, pesticides
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any contaminated, non-impervious clothing immediately Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Varies with compound type; tetra isomer toxic by ingestion; teratogenic effects
FIRST AID:	Eye: Irrigate immediately Skin: Immediately wash with soap and water Breath: Artificial respiration Ingestion: Seek prompt immediate medical attention
TARGET ORGANS:	Digestive system central nervous system
FLAMMABILITY:	Not available

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

1,1-Dichloroethane

SYNONYMS:

Ethylidene dichloride

PERMISSIBLE EXPOSURE LIMIT:

100 ppm (OSHA)

IDLH LEVEL:

4,000 ppm

ODOR THRESHOLD:

120 ppm; chloroform-like odor

PHYSICAL DESCRIPTION:

Colorless liquid

PERSONNEL PROTECTION AND
SANITATION:

Respiratory Protection: Required; see
Section 5

Protective Clothing: Required; see
Section 5

Remove: Any contaminated non-impermeable
clothing

Provide: Eyewash

ROUTES OF ENTRY:

Inhalation, Ingestion, Contact

SYMPTOMS:

Skin irritation, drowsiness, nervous
system depression, liver & Kidney
damage

FIRST AID:

Eye: Irrigate immediately

Skin: Wash promptly after skin contact

Breath: Artificial respiration

Ingestion: Immediate medical attention

TARGET ORGANS:

Skin, liver, kidneys

FLAMMABILITY:

Lower Explosive Limit: 6%
Upper Explosive Limit: 16%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

1,1-Dichloroethylene

SYNONYMS:	Vinylidene Chloride
PERMISSIBLE EXPOSURE LIMIT:	1 ppm (OSHA)
IDLH LEVEL:	N/A
ODOR THRESHOLD:	
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Immediately any contaminated, non- impervious clothing Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	General anesthesia; eye, nose and throat irritation; dizziness, intoxication, potential carcinogen, teratogen and mutagen
FIRST AID:	Eye: Irrigate immediately Skin: Wash exposed skin immediately Breath: Artificial respiration Ingestion: Get medical attention
TARGET ORGANS:	CNS, skin, eyes
FLAMMABILITY:	Lower Explosive Limit: 7.3% Upper Explosive Limit: 16%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

1,2-Dichloroethylene

SYNONYMS:	Trans-1,2-dichloroethylene, dichloride	Acetylene
PERMISSIBLE EXPOSURE LIMIT:	200 ppm (OSHA)	
IDLH LEVEL:	4,000 ppm	
ODOR THRESHOLD:	N/A; ether-like odor	
PHYSICAL DESCRIPTION:	Colorless liquid	
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required; see Section 5 Protective Clothing: See Section 5 Goggles/Glasses: Required see Section 6 Remove: Any wet non-impervious clothing Provide: Eye wash	
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact	
SYMPTOMS:	Eye, respiratory irritation, central nervous system depression	
FIRST AID:	Eye: Irrigate immediately Skin: Wash promptly after skin contact Breath: Artificial respiration Ingestion: Get medical attention	
TARGET ORGANS:		
FLAMMABILITY:	Lower Explosive Limit: 9.7 percent Upper Explosive Limit: 12.8 percent	

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Diesel Fuel

SYNONYMS:	Fuel Oil 1D, 2D
PERMISSIBLE EXPOSURE LIMIT:	No single TLV or PEL applicable
IDLH LEVEL:	Not available
ODOR THRESHOLD:	Not available; fuel-like odor
PHYSICAL DESCRIPTION:	Light brown viscous fluid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Gloves/Goggles: Required, see Section 5 Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion
SYMPTOMS:	Diarrhea, eye and skin irritation
FIRST AID:	Eye: Irrigate immediately Skin: Wash with soap and water promptly Breath: Artificial respiration Ingestion: Seek prompt medical attention
TARGET ORGANS:	Gastrointestinal system, eyes, skin
FLAMMABILITY:	Lower Explosive Limit: 1.3% Upper Explosive Limit 6.0%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

	Dioxins
SYNONYMS:	Penta, Octa, Hepta, Hexachloro dibenzodioxins
PERMISSIBLE EXPOSURE LIMIT:	Not Listed
IDLH LEVEL:	N/A; suspected carcinogens
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Viscous liquids, solids, varies with compound
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious clothing immediately Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, skin, respiratory irritation, liver and kidney abnormalities; teratogenic effects; symptoms vary with substance
FIRST AID:	Eye: Irrigate immediately Skin: Wash with soap and water immediately Breath: Artificial respiration Ingestion: Seek immediate medical attention
TARGET ORGANS:	Skin, eye, respiratory, gastrointestinal systems, CNS
FLAMMABILITY:	Not Specified

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Ethylbenzene

SYNONYMS:	Phenylethane, Ethylbenzol
PERMISSIBLE EXPOSURE LIMIT:	100 ppm (OSHA) 125 STEL (OSHA)
IDLH LEVEL:	2,000 ppm
ODOR THRESHOLD:	0.46 ppm; Aromatic Odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: See Section 5 Goggles/Glasses: See Section 5 Remove: Any contaminated non-impervious clothing
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	eyes, nose irritation, headache, eye dermatitis, narcosis, coma
FIRST AID:	Eye: Irrigate immediately Skin: Flush exposed skin promptly Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	
FLAMMABILITY:	Lower Explosive Limit: 1.0% Upper Explosive Limit: 6.7%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Freon 114

SYNONYMS:	Dichlorotetrafluoroethane
PERMISSIBLE EXPOSURE LIMIT:	1,000 ppm (OSHA)
IDLH LEVEL:	50,000 ppm
ODOR THRESHOLD:	Not available/ ethereal odor
PHYSICAL DESCRIPTION:	Colorless gas
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Gloves/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious clothing promptly Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Respiratory irritation, asphyxia; cardiac arrest
FIRST AID:	Eye: Irrigate immediately Skin: Flush skin immediately Breath: Artificial respiration Ingestion: Seek immediate medical attention
TARGET ORGANS:	Respiratory system, cardiovascular system
FLAMMABILITY:	Non Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Hydrogen Cyanide

SYNONYMS:	Hydrocyanic acid, Prussic acid, Formonitrite
PERMISSIBLE EXPOSURE LIMIT:	10 ppm (11 mg/m ³) (OSHA) 4.7 ppm (5 mg/m ³) 10 min. ceil. (NIOSH) 10 ppm (10 mg/m ³) ceil. (ACGIH)
IDLH LEVEL:	50 ppm
ODOR THRESHOLD:	1 mg/m ³
PHYSICAL DESCRIPTION:	Colorless or pale blue liquid or gas with a bitter almond odor
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any wet clothing immediately (flammable) Provide: Eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Asphyxia and death at high levels; weak, headache, confusion, nausea, vomiting; increase rate & depth of respiration or respiration slow and gasping
FIRST AID:	Eye: Irrigate immediately Skin: Water flush immediately Breath: Artificial respiration use Amyl Nitrite Pearls Ingestion: Drink water, force vomit
TARGET ORGANS:	CNS, CVS, liver, kidneys
FLAMMABILITY:	Lower Explosive Limit: 5.0%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Isopropanol

SYNONYMS:	2-Propanol
PERMISSIBLE EXPOSURE LIMIT:	400 ppm (OSHA) 500 ppm short-term exposure limit (OSHA) 400 ppm (NIOSH) 800 ppm, 15 min. ceiling (NIOSH)
IDLH LEVEL:	12,000 ppm
ODOR THRESHOLD:	10-100 ppm; alcohol odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any wet clothing promptly (flammable) Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, nose and throat irritation, dermatitis, dizziness, drowsiness, drunkenness, vomiting
FIRST AID:	Eye: Irrigate immediately (15+ minutes) Skin: Flush with water Breath: Artificial respiration Ingestion: Seek medical attention; drink water or milk
TARGET ORGANS:	Eyes, skin, respiratory system
FLAMMABILITY:	Lower Explosive Limit: 2% Upper Explosive Limit: 12.6%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Lead (Dust)

SYNONYMS:	Varies
PERMISSIBLE EXPOSURE LIMIT:	0.05 mg/m ³ (OSHA)
IDLH LEVEL:	N/A
ODOR THRESHOLD:	Varies, based upon compound
PHYSICAL DESCRIPTION:	Varies, based upon compound
PERSONNEL PROTECTION AND SANITATION:	Provide: Eyewash station
ROUTES OF ENTRY:	Inhalation, Ingestion
SYMPTOMS:	Lassitude, insomnia, weight loss, abdominal pain, anemia
FIRST AID:	Eye: Irrigate immediately Skin: Soap and water wash promptly Breath: Artificial respiration Swallow: Get medical attention
TARGET ORGANS:	Central nervous system, kidneys, blood
FLAMMABILITY:	Not Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Manganese

SYNONYMS:	Varies, based upon compound
PERMISSIBLE EXPOSURE LIMIT:	5 mg/m ³ (ceiling) (OSHA)
IDLH LEVEL:	10,000 mg/m ³
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Gray solid
PERSONNEL PROTECTION AND SANITATION:	NA
ROUTES OF ENTRY:	Inhalation, Ingestion
SYMPTOMS:	Sluggishness, sleepiness, reduced resistance to respiratory infections
FIRST AID:	Breath: Artificial respiration Swallow: Medical attention immediately
TARGET ORGANS:	Central nervous system, kidneys, blood
FLAMMABILITY:	Not Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Mercury (Inorganic)

SYNONYMS:

Quicksilver

PERMISSIBLE EXPOSURE LIMIT:

0.1 mg/m³ ceiling (OSHA)
0.05 mg/m³ (NIOSH, ACGIH)

IDLH LEVEL:

28 mg/m³

ODOR THRESHOLD:

Odorless

PHYSICAL DESCRIPTION:

Varies with compound type

PERSONNEL PROTECTION AND
SANITATION:Respiratory Protection: Required, see Section
5Protective Clothing: Required, see Section
5Glasses/Goggles: Required, see Section 5
Remove: Any non-impervious

contaminated clothing

Provide: Eyewash, quick drench

ROUTES OF ENTRY:

Inhalation, Ingestion, Contact

SYMPTOMS:

Cough, bronchitis, tremors, insomnia,
irritability, headache, fatigue, weakness,
anorexia, eye and skin irritation,
paresthesia, ataxia, vision loss, spasms,
nausea, diarrhea

FIRST AID:

Eye: Irrigate immediately

Skin: Immediately wash with soap and water

Breath: Artificial respiration

Ingestion: Seek immediate medical attention;

TARGET ORGANS:

CNS, skin, kidneys, eyes

FLAMMABILITY:

Not Combustible

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Mercury (Organic)

SYNONYMS:	Varies with compound type
PERMISSIBLE EXPOSURE LIMIT:	0.01 mg/m ³ (OSHA) 0.004 mg/m ³ Ceiling (OSHA)
IDLH LEVEL:	10 mg/m ³
ODOR THRESHOLD:	Odor varies with compound type
PHYSICAL DESCRIPTION:	Varies with compound type
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any non-impervious clothing immediately Provide: Eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Visual and hearing impairment, emotional shifts, jerky motions, paresthesia, dizziness, salivation, nausea, vomiting, diarrhea, dermatitis
FIRST AID:	Eye: Irrigate immediately Skin: Immediately wash with soap and water Breath: Artificial respiration Ingestion: Seek prompt immediate medical attention
TARGET ORGANS:	CNS, skin, kidneys, eyes
FLAMMABILITY:	Varies with compound type Upper Explosive Limit 6.0%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Methylene Chloride

SYNONYMS:	Dichloromethane
PERMISSIBLE EXPOSURE LIMIT:	50 ppm (ACGIH)
IDLH LEVEL:	N/A; carcinogen
ODOR THRESHOLD:	0.37 ppm; chloroform - like odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required see Section 5 Protective Clothing: Required; see Section 6 Goggles/Glasses: Required See Section 6
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Fatigue, nausea, sleepiness, numbness, tingling, vertigo, eye and skin irritation, suspected carcinogen
FIRST AID:	Eye: Irrigate immediately Skin: Wash exposed skin promptly Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Skin, CNS, Cardiovascular system, eyes
FLAMMABILITY:	Lower Explosive Limit: 12% Upper Explosive Limit: 19%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Methyl Ethyl Ketone

SYNONYMS:	2-Butanone
PERMISSIBLE EXPOSURE LIMIT:	200 ppm (OSHA) 300 ppm short-term exposure limit (OSHA) 200 ppm (NIOSH) (590 mg/m ³)
IDLH LEVEL:	3,000 ppm
ODOR THRESHOLD:	25-30 ppm; mint-like odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious clothing Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, and nose irritation, headache, dizziness, vomiting
FIRST AID:	Eye: Irrigate immediately Skin: Wash immediately Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Eyes, skin, central nervous system, respiratory system
FLAMMABILITY:	Lower Explosive Limit: 2% Upper Explosive Limit: 10%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Mineral Spirits

SYNONYMS:	Petroleum Spirits, Naphtha
PERMISSIBLE EXPOSURE LIMIT:	Not Specified 100 ppm (OSHA) Naphtha
IDLH LEVEL:	10,000 ppm as Naphtha
ODOR THRESHOLD:	Gasoline-like odor
PHYSICAL DESCRIPTION:	Colorless to brown liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious clothing promptly Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS: depression	Skin and eye irritant, excitement,
FIRST AID:	Eye: Irrigate immediately Skin: Wash with soap and water promptly Breath: Artificial respiration Ingestion: Seek immediate medical attention
TARGET ORGANS:	Eyes, skin, respiratory system
FLAMMABILITY:	Lower Explosive Limit: 0.8% Lower Explosive Limit: 5%

TABLE 3.2

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Nickel (Soluble)

SYNONYMS:	Varies with compound
PERMISSIBLE EXPOSURE LIMIT:	0.1 mg/m ³ (OSHA)
IDLH LEVEL:	N/A, Carcinogen
ODOR THRESHOLD:	N/A
PHYSICAL DESCRIPTION:	Solid
PERSONNEL PROTECTION AND SANITATION:	Protective Clothing: Required, see Section 5 Remove: Any wet clothing promptly Provide: Eyewash station
ROUTES OF ENTRY:	Inhalation, ingestion , contact
SYMPTOMS:	Dermatitis, asthma, nasal and lung cancer
FIRST AID:	Skin: Flush or wash immediately after skin contact Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Lungs, skin, nasal cavaties
FLAMMABILITY:	Not Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Nitric Acid

SYNONYMS:	Hydrogen Nitrate, Aqua Fortis
PERMISSIBLE EXPOSURE LIMIT:	2 ppm (OSHA) 4 ppm short-term exposure limit (OSHA) 2 ppm (NIOSH)
IDLH LEVEL:	100 ppm
ODOR THRESHOLD:	Choking odor
PHYSICAL DESCRIPTION:	Colorless to light brown liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Gloves/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious contaminated clothing Provide: Eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, skin irritation or burns, dental erosion, pulmonary edema, bronchitis (delayed), unconsciousness
FIRST AID:	Eye: Irrigate immediately (15+ minutes) Skin: Flush immediately Breath: Artificial respiration Ingestion: Seek immediate medical attention; drink water or milk
TARGET ORGANS:	
FLAMMABILITY:	Not Combustible, but reactive

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Pentachlorophenol

SYNONYMS:	Penta, PCP
PERMISSIBLE EXPOSURE LIMIT:	0.5 mg/m ³ skin (OSHA)
IDLH LEVEL:	150 mg/m ³
ODOR THRESHOLD:	10.9 mg/m ³ (irritating concentration)
PHYSICAL DESCRIPTION:	Light brown solid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Immediately any contaminated, non-impervious clothing Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, nose, throat irritation; sneezing coughing, anorexia, sweating, headache, dizziness, nausea, vomiting, chest pain, dermatitis, liver & kidney damage
FIRST AID:	Eye: Irrigate immediately Skin: Soap wash immediately Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Kidneys, liver, skin, eyes, CNS, respiratory system
FLAMMABILITY:	Not flammable

TABLE 3.2

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Polychlorinated Biphenyls

SYNONYMS:	Arochlor 1242 Arochlor 1254
PERMISSIBLE EXPOSURE LIMIT:	0.1 mg/m ³ skin (OSHA) (Arochlor 1242) 0.5 mg/m ³ skin (OSHA) (Arochlor 1254)
IDLH LEVEL:	N/A
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Viscous liquid
PERSONNEL PROTECTION AND SANITATION:	Protective Clothing: Required, see Section 5 Remove: Any contaminated clothing immediately
ROUTES OF ENTRY:	Inhalation, ingestion, contact
SYMPTOMS:	Dermatitis, liver dysfunction, chloracne, central nervous system effects, teratogenic effects, weakness, numbness
FIRST AID:	Eye: Irrigate immediately Skin: Wash with promptly after skin contact Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Lungs, skin, eyes, liver eyes, skin
FLAMMABILITY:	Lower Explosive Limit: Not available Upper Explosive Limit: Not available

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Sodium Hydroxide

SYNONYMS:	Caustic Soda, Lye
PERMISSIBLE EXPOSURE LIMIT:	2 mg/m ³ ceiling (OSHA) 2 mg/m ³ ceiling (NIOSH, ACGIH)
IDLH LEVEL:	200 mg/m ³
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Colorless solid/liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious clothing immediately Provide: Eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Severe eye and gastrointestinal damage, skin burns, eye, nose, throat irritation
FIRST AID:	Eye: Irrigate immediately (15 minutes) Skin: Flush with water immediately Breath: Artificial respiration Ingestion: Seek immediate medical attention; drink water or milk
TARGET ORGANS:	Eyes, skin, respiratory and gastrointestinal systems
FLAMMABILITY:	Not Combustible

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Stoddard Solvent

SYNONYMS:	Mineral Spirits, Safety Solvent
PERMISSIBLE EXPOSURE LIMIT:	500 ppm (OSHA) 350 mg/m ³ per 10 hr. period (NIOSH) 1800 mg/m ³ 15 min. ceiling (NIOSH)
IDLH LEVEL:	5,000 ppm
ODOR THRESHOLD:	Kerosene-like
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any contaminated non-impervious clothing promptly Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, nose, throat irritation; dizziness; dermatitis
FIRST AID:	Eye: Irrigate immediately Skin: Wash with soap and water promptly Breath: Artificial respiration Ingestion: Obtain immediate medical attention
TARGET ORGANS:	Central nervous system, eyes, nose, throat
FLAMMABILITY:	Lower Explosive Limit: 0.8% Upper Explosive Limit: Undefined

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Strychnine

SYNONYMS:	None
PERMISSIBLE EXPOSURE LIMIT:	0.15 mg/m ³ (OSHA)
IDLH LEVEL:	3 mg/m ³
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Solid, colorless
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Gloves/Goggles: Required, see Section 5 Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion
SYMPTOMS:	Reflex excitation, convulsions, apprehension
FIRST AID:	Eye: Irrigate immediately Skin: Wash with strong soap and water promptly Breath: Artificial respiration Ingestion: Immediate medical attention; ingest activated charcoal slurry
TARGET ORGANS:	Central nervous system
FLAMMABILITY:	Not Flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Sulfuric Acid

SYNONYMS:	Oil of Vitriol
PERMISSIBLE EXPOSURE LIMIT:	1 mg/m ³ (OSHA) 1 mg/m ³ (NIOSH)
IDLH LEVEL:	80 mg/m ³
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Colorless to black liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Gloves/Goggles: Required, see Section 5 Remove: Immediately, any non-impervious clothing Provide: Eyewash, quick drench
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, nose, throat, skin irritation; severe eye, skin burns upon contact, dental erosion; emphysema; pulmonary edema
FIRST AID:	Eye: Irrigate immediately Skin: Flush skin immediately Breath: Artificial respiration Ingestion: Seek immediate medical attention; drink water or milk
TARGET ORGANS:	Skin, eyes, respiratory, and gastrointestinal system
FLAMMABILITY:	Highly reactive, not combustible

TABLE 3.2

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Technetium - 99 (Tc-99)

SYNONYMS:	Class "W" Tc-99 18,900 dpm/ft ³ (DOE) 1,900 dpm/ft ³ (PORTS) Class "D" Tc-99 125,000 dpm/ft ³ (DOE) 1,900 dpm/ft ³ (PORTS)
PERMISSIBLE EXPOSURE LIMIT:	0.1 mg/m ³ skin (OSHA) (Arochlor 1242) 0.5 mg/m ³ skin (OSHA) (Arochlor 1254)
IDLH LEVEL:	N/A; radioactive carcinogen
ODOR THRESHOLD:	N/A; odorless
PHYSICAL DESCRIPTION:	Varies; solid, gas, soluble forms
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated, non-impervious clothing
ROUTES OF ENTRY:	Inhalation, ingestion, contact
FIRST AID:	Eye: Irrigate immediately Skin: Thorough scrubbing skin contact Breath: Artificial respiration Ingestion: Get immediate medical attention
TARGET ORGANS:	Skin, gastrointestinal tract, respiratory system (primarily radiation hazard)

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Thorium - 234

SYNONYMS:	Varies with compound type
PERMISSIBLE EXPOSURE LIMIT:	9×10^{-8} uCi/ml (air)
IDLH LEVEL:	N/A; radioactive carcinogen
ODOR THRESHOLD:	Odorless
PHYSICAL DESCRIPTION:	Solid, gas
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Glasses/Goggles: Required, see Section 5 Remove: Any contaminated clothing promptly Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye, nose, throat, skin irritation; changes in blood chemistry, bones, blood; radiation disease.
FIRST AID:	Eye: Irrigate immediately Skin: Flush with water Breath: Artificial respiration Ingestion: get immediate medical attention
TARGET ORGANS:	Skeletal, lymphatic, respiratory, circulatory systems
FLAMMABILITY:	Flammable Solid

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

	Toluene
SYNONYMS:	Toluol
PERMISSIBLE EXPOSURE LIMIT:	100 ppm TWA (OSHA) 150 ppm STEL (OSHA)
IDLH LEVEL:	2,000 ppm
ODOR THRESHOLD:	0.25 ppm; aromatic, benzene-like odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Protective Clothing: Required; see Section 5 Provide: Eyewash station
ROUTES OF ENTRY:	Inhalation, Absorption, Ingestion
SYMPTOMS:	Fatigue, confusion, weakness, euphoria, dizziness, headache, insomnia, dermatitis
FIRST AID:	Eye: Irrigate immediately Skin: Wash promptly after skin contact Breath: Artificial respiration Ingestion: Get medical attention
TARGET ORGANS:	Central nervous system, skin
FLAMMABILITY:	Lower Explosive Limit: 1.3% Upper Explosive Limit: 7.1%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

1,1,1-Trichloroethane

SYNONYMS:	Methyl Chloroform
PERMISSIBLE EXPOSURE LIMIT:	350 ppm (TWA) 450 ppm (STEL) (OSHA)
IDLH LEVEL:	1,000 ppm
ODOR THRESHOLD:	13 ppm; chloroform-like odor
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated, non- impervious clothing Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Eye and skin irritation, irritability, agression, euphoria, diarrhea, nausea, possible mutagen and carcinogen
FIRST AID:	Eye: Irrigate immediately Skin: Wash exposed skin promptly Breath: Artificial respiration Ingestion: Medical attention
TARGET ORGANS:	Skin, CNS, eyes, cardiovascular system
FLAMMABILITY:	Lower Explosive Limit: 7% Upper Explosive Limit: 16%

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

1,1,2-Trichloroethane

SYNONYMS:	Vinyl Trichloride
PERMISSIBLE EXPOSURE LIMIT:	10 ppm skin (OSHA)
IDLH LEVEL:	N/A
ODOR THRESHOLD:	N/A
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated, non- impervious clothing immediately Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Contact, Ingestion
SYMPTOMS:	Eye and skin irritation, CNS depression, liver and kidney damage
FIRST AID:	Eye: Irrigate immediately Skin: Wash exposed skin promptly Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	
FLAMMABILITY:	Lower Explosive Limit: 6% Upper Explosive Limit: 15.5%

TABLE 3.2

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Trichloroethylene

SYNONYMS:	Triclene, Ethylene Trichloride
PERMISSIBLE EXPOSURE LIMIT:	50 ppm TWA (OSHA) 2000 ppm STEL (OSHA)
IDLH LEVEL:	N/A
ODOR THRESHOLD:	21.4 ppm
PHYSICAL DESCRIPTION:	Colorless liquid
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 6 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated, non-impervious clothing
ROUTES OF ENTRY:	Inhalation, ingestion, contact
SYMPTOMS:	Headache, nausea, vomiting, dermatitis, eye irritation, paresthesia
FIRST AID:	Eye: Irrigate immediately Skin: Wash promptly after skin contact Breath: Artificial respiration Ingestion: Medical attention
TARGET ORGANS:	Heart, liver, kidneys, respiratory system
FLAMMABILITY:	Lower Explosive Limit: 11 percent Upper Explosive Limit: 41 percent

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Uranium (soluble)

SYNONYMS:	Varies with compound
PERMISSIBLE EXPOSURE LIMIT:	0.05 mg/m ³ (OSHA)
IDLH LEVEL:	20 mg/m ³ ; radioactive carcinogen
ODOR THRESHOLD:	varies with compound
PHYSICAL DESCRIPTION:	varies with compound
PERSONNEL PROTECTION AND SANITATION:	Respiratory Protection: Required, see Section 5 Protective Clothing: Required, see Section 5 Goggles/Glasses: Required, see Section 6 Remove: Any contaminated, non- impervious clothing Provide: Eyewash
ROUTES OF ENTRY:	Inhalation, Ingestion, Contact
SYMPTOMS:	Shortness of breath, conjunctivitis, cough, nausea, vomiting, skin burns, casts in urine, red blood cell drop, high BUN
FIRST AID:	Eye: Irrigate immediately Skin: Flush exposed skin immediately Breath: Artificial respiration Ingestion: Immediate medical attention
TARGET ORGANS:	Respiratory system, blood, bone marrow, skin, liver, kidneys
FLAMMABILITY:	Varies; some particulates flammable

TABLE 3.2 (Cont.)

SUBSTANCES OF HEALTH AND SAFETY CONCERN

Xylene Isomers

SYNONYMS:	o-Xylene, m-Xylene, p-Xylene
PERMISSIBLE EXPOSURE LIMIT:	100 ppm (TWA) 150 ppm (STEL) (OSHA)
IDLH LEVEL:	10,000 ppm
ODOR THRESHOLD:	0.26-4.13 ppm; aromatic odor
PHYSICAL DESCRIPTION:	Colorless liquid/solid
PERSONNEL PROTECTION AND SANITATION:	Protective Clothing: Required; see Section 5 Provide: Eyewash station
ROUTES OF ENTRY:	Inhalation, Absorption, Ingestion
SYMPTOMS:	Dizziness, excitement, drowsiness, incoherence, irritation to eyes and nose, anorexia, nausea, dermatitis
FIRST AID:	Eye: Irrigate immediately Skin: Wash promptly after skin contact Breath: Artificial respiration Ingestion: Get medical attention
TARGET ORGANS:	Eyes, central nervous system, digestive tract
FLAMMABILITY:	Lower Explosive Limit: 1.0% Upper Explosive Limit: 6.0%

TABLE 3.3
CONTAMINANTS WHICH MAY BE ENCOUNTERED
DURING QUADRANT II FIELD ACTIVITIES

HMES UNIT NUMBER	UNIT NAME	RECIRCULATING COOLING WATER (RCW)	RADIONUCLIDES	ORGANIC COMPOUNDS (Solvents, etc.)	INORGANIC COMPOUNDS (Metals, Etc.)	PCBs	DIOXINS	ASBESTOS	WASTE OIL
X-230J7	East Holding Pond Oil Separation Basin		-	+	+	+			+
X-633	RCW Pumphouse and Cooling Towers	+			+			+	
X-700	Chemical Cleaning Facility		-	+	+				
X-700	TCE/TCA Storage Tanks			+					
X-700	Chemical and Petroleum Storage Tanks			+					
X-701	N.E. Biodegradation Plots		+	+		+			+
x-701C	Neutralization Pit			+	+				
X-705	Decontamination Building		+	+	+				
X-705A	Radioactive Waste Incinerator		-	-	-		+		
X-705B	Burnable Storage Lot		+						
X-720	Maintenance Stores Building		+	+	+				
X-720	Neutralization Pit		+	+	+				
X-744G	Bulk Storage Building		+	+		+			
X-744	Retrievable Waste Storage Area		+						
	East Drainage Ditch and Little Beaver Creek		+	-	+	-			+

NOTES:

- + Known to have been used/buried/discharged into subject unit
- Substance might be present/discharged into subject unit

Potentially hazardous constituents within each category are listed in Table 3.1.

E 3.3 (cont.)

CONTAMINANTS WHICH MAY BE ENCOUNTERED
DURING QUADRANT II FIELD ACTIVITIES

MMES UNIT NUMBER	UNIT NAME	RECIRCULATING COOLING WATER (RCW)	RADIONUCLIDES	ORGANIC COMPOUNDS (Solvents, etc.)	INORGANIC COMPOUNDS (Metals, Etc.)	PCBs	DIOXINS	ASBESTOS	WASTE OIL
X-700 to X-705	Process Lines		+	+	+				
	Sanitary Sewer System		+	+	+				
X-614P	N.E. Sewage Lift Station		-	-	+				-
	Storm Sewer D and E		-	-	+				-

NOTES:

- + Known to have been used/buried/discharged into subject unit
- Substance might be present/discharged into subject unit

Potentially hazardous constituents within each category are listed in Table 3.1.

TABLE 3.4
ACTIVITIES TO BE PERFORMED DURING THE QUADRANT II RFI

MMES UNIT NUMBER	UNIT NAME	SOIL BORING WITH SAMPLING	MONITORING WELL INSTALLATION	BASIN/PIT/ POND SEDIMENT SAMPLING	STREAM/DITCH SEDIMENT SAMPLING	SURFACE- WATER SAMPLING	GROUND- WATER SAMPLING	TANK SAMPLING	TEST PIT INVESTIGATION
X-230J7	East Holding Pond Oil Separation Basin			X X					
X-633	RCW Pumphouse and Cooling Towers	X	X				X		
X-700	Chemical Cleaning Facility	X	X				X		
X-700	TCE/TCA Storage Tanks	X							
X-700	Chemical And Petroleum Storage Tanks	X						X	
X-701	N.E. Biodegradation Plots	X							
X-701C	Neutralization Pit	X	X				X		
X-705	Decontamination Building	X	X				X		
X-705A	Radioactive Waste Incinerator	X							
X-705B	Burnable Storage Lot	X							
X-720	Maintenance and Stores Building	X	X				X		
X-720	Neutralization Pit			X					
X-744G	Bulk Storage Building	X							
X-744	Retrievable Waste Storage Area	X							
	East Drainage Ditch and Little Beaver Creek	X			X	X			
X-700 to X-705	Process Lines	X							X
	Sanitary Sewer System	X							
X-614P	Northeast Sewage Lift Station	X							
	Storm Sewers D and E	X							

3.1 Exposure Pathways

The main pathways of exposure to potentially harmful substances which may be encountered during Quadrant II RFI activities are summarized in Table 3.2.

3.1.1 Inhalation

A principal pathway of exposure for volatile organic compounds (VOCs) such as trichloroethylene and 1,1,1-trichloroethane and hydrogen cyanide is via inhalation of organic vapors emanating from excavated soils or contaminated fluids. Inhalation of contaminated solid or liquid aerosols are a potential exposure pathway for less volatile organics (i.e. PCBs) radionuclides, and inorganic substance such as asbestos, chromium, and other metals.

Tasks which exhibit the greatest potential for inhalation of potentially harmful substances include drilling with soil sampling; monitoring well installation, development and sampling; test pit excavation; and, to a lesser extent, sediment sampling. Except for test pit excavation along former process lines, the volume of soil/sediment to be disturbed should be minimal, reducing the potential for generation and inhalation of particulates containing potentially harmful constituents.

Inhalation of vapor containing recirculating cooling water-related substances, such as arsenic, dichromate and chromium, may be a particularly significant exposure pathway in the vicinity of the X-633 units. As of August, 1989, a chromated inhibitor is no longer used in the RCW system while tests are being performed with a phosphate inhibitor.

Exposure via inhalation will be controlled through atmospheric monitoring during RFI tasks coupled with respiratory protection, where needed (see Sections 5 and 7). The degree of respiratory protection to be adopted will be dependent upon real time monitoring results, as confirmed by quantitative determination of contaminants during the tasks to be performed, but may consist of full-face, air-purifying respirators (FFAPRs), or positive-pressure supplied-air systems.

3.1.2 Dermal Contact

Physical contact with contaminated media (i.e., soil and water) during RFI activities is the principal means of exposure to PCBs, dioxins, inorganics such as acids, nickel and chromium, and VOCs, as well as alpha, beta and gamma radiation sources. The potential for direct contact with contaminated media exists during all RFI work tasks, as summarized on Table 3.4. Personal Protective Equipment (PPE) to be employed by personnel will be

resistant to the substances which may be encountered; PPE and standard operating practices are described in Sections 5 and 8.

3.1.3 Ingestion

Ingestion of matrices containing potentially hazardous substances will be controlled through the use of good hygiene and enforcement of work area prohibitions outlined in Section 8.

3.2 Health Effects

3.2.1 Ionizing Radiation

Radioactive materials emit one or more of four types of potentially harmful radiation: (alpha, beta, gamma and neutron). Alpha radiation has limited penetrating ability and is usually stopped by clothing and outer layers of the skin. Alpha radiation poses little threat outside the body, but can be hazardous if materials that emit alpha radiation are inhaled or ingested. Beta radiation can cause harmful "beta burns" to the skin and change the subsurface blood system. Beta radiation is also hazardous if materials that emit beta radiation are inhaled or ingested. Use of protective clothing, coupled with scrupulous personal hygiene and decontamination, afford good protection against alpha and beta radiation. In addition, use of respiratory and other protective

equipment can help keep radiation-emitting materials from entering the body by inhalation, ingestion, injection, or skin absorption.

Gamma and neutron radiation easily pass through clothing and human tissue and can also cause serious permanent damage to the body. Chemical-protective clothing affords no protection against these types of radiation.

In the event that levels of radiation encountered during RFI activities exceed the established action levels (Section 7), all activities shall cease until the situation has been assessed by an MMES health physicist and appropriate safeguards and procedures have been implemented.

3.2.2 Organic Chemicals

Volatile organic compounds (VOCs) which may be encountered during Quadrant II RFI activities are listed under "Organic Chemicals" in Table 3.1. VOCs are central nervous system depressants which produce similar symptoms in victims exposed to moderate vapor-phase concentrations, or, for certain compounds, through skin absorption (see Table 3.2 for compound-specific symptoms). General symptoms of VOC exposure, both acute and chronic, may include euphoria, headache, weakness, dizziness, nausea, narcosis, and possibly coma. Certain VOCs are also skin and eye irritants (see Table 3.2). Chloroform, methylene

chloride, benzene, and carbon tetrachloride are suspected or confirmed human carcinogens.

Worker exposure to VOCs will be controlled through the proper use of personal protective equipment combined with atmospheric monitoring (both qualitative and quantitative, see Section 7) for organic vapors. The degree of respiratory protection to be adopted will be dependent upon monitoring results and the task to be performed, but may consist of full-face, air-purifying respirators (FFAPRs).

Systemic effects of PCB exposure in humans include anorexia, nausea, edema of face and hands and abdominal pains. Polychlorinated biphenyls (PCBs) can produce skin sensitization and chloracne at low concentrations ($<10 \text{ mg/m}^3$) in sensitive populations. These substances bioaccumulate in body fat and fat-containing organs and are not readily removed by the body. PCBs are suspected human carcinogens, suspected teratogens (i.e., producing birth defects) and are toxic to the liver. Occupational exposure to PCBs has been shown to produce changes in liver function and weight. Case studies of exposed workers indicate that the principal mode of PCB uptake by the body is via dermal contact or ingestion.

PCBs have been detected in ditch sediments (up to 62 ppm) near the northeastern biodegradation plots (X-701) and may be associated with soil or other substrate in or near the bulk storage building (X-744G). PCBs characteristically exhibit a strong affinity to soil material or similar substrate, and pose mainly a dermal contact hazard. PPE selected for use during the Quadrant II RFI will afford protection against dermal exposure to soil-borne PCBs.

Pentachlorophenol (PCP) was used as a preservative/fungicide in recirculating cooling water until 1982, when it was replaced with cupric arsenate. PCP is readily absorbed through the skin, and can ultimately result in cumulative intoxication and death. Symptoms of PCP poisoning include acneform dermatitis on exposed skin (prolonged exposure), weakness, nausea, vomiting, anorexia, headache, intense thirst, pain in the extremities, hyperpyrexia, tachycardia, tachypnea, and possibly death. Chronic exposure to PCP may product conjunctivitis, chronic sinusitis, bronchitis, polyneuritis and dermatitis in exposed populations. PCP is an animal teratogen. Due to its past history of use, PCP may be encountered in soil or ground water affected by RCW drift or leakage.

Cyanide affects the cardiovascular and central nervous system, kidneys and liver. Exposure to high cyanide levels via ingestion or inhalation leads to unconsciousness, cessation of

breathing and possibly death due to metabolic asphyxiation. At low exposure levels ($<5 \text{ mg/m}^3$) headache, confusion and nausea may be experienced, and an odor of bitter almonds may be detected. Early warning signs of exposure are; headache, nausea, weakness and dizziness. Cyanosis, a blue discoloration of the lips and fingernails, is also a typical symptom of cyanide exposure.

Electroplating solutions containing cyanide salts have been discharged to the X-720 neutralization pit, along with spent acid and alkaline cleaning solutions from the X-720 maintenance building. Due to the heterogeneous composition of the waste stream, a potential exists for the liberation of hydrogen cyanide gas from the cyanide salts in the neutralization pit. A continuously-recording hydrogen cyanide monitor will be employed during neutralization pit sampling activities, to prevent exposure of personnel to HCN gas. Respiratory action levels are outlined in Section 7.

Dibenzodioxins and dibenzofurans vary in degree of toxicity and severity of damage to the body. Less toxic forms produce respiratory and eye irritation upon exposure and are generally potent toxins by ingestion, while the highly toxic 2, 3, 7, 8-tetrachlorodibenzo-p-dioxin (TCDD) can produce chloracne and abnormalities of the liver, pancreas, circulatory and respiratory systems in persons exposed via inhalation, ingestion or contact with low to moderate part-per-billion concentrations.

Hepta-, penta-, hexa-, and octachlorodibenzodioxins and dibenzofurans have been detected at low part-per-billion concentrations (0.15 to 4.9 ppb) in soil near the X-705A incinerator. Personal protective equipment outlined on Table 7.1 will afford protection against soil and dust borne dibenzodioxins and dibenzofurans.

3.2.3 Inorganic Chemicals or Substances

Iron, lead, barium, nickel, manganese, chromium, and chromates (hexavalent chrome) may affect a host of bodily systems, dependent upon the substance in question and the pathway of exposure. Symptoms of exposure to these substances are given in Table 3.2 and include dermatitis, asthma, insomnia, anorexia, anemia, sluggishness, kidney necrosis and lung fibrosis.

Inorganic substances will primarily be associated with contaminated soil and ground water and should pose little or no hazard to personnel wearing the prescribed level of protection for a work task. Chromium and dichromate concentrations in RCW drift (if chromate inhibitor use is resumed) will be assessed prior to and during RFI activities in the X-633 area, in order to determine the proper level of protection to be adopted.

Arsenic, as cupric arsenate, is present in RCW and may be present in RCW drift and leakage. Arsenic is highly toxic in both the solid and dissolved forms, with ingestion causing mucous membrane irritation, weakness, loss of appetite, peripheral neuropathy, and skin disorders. Initial exposure symptoms consist of burning lips, throat constriction, severe abdominal pain, nausea and vomiting, and profuse diarrhea. Overdoses lead to eventual damage to the liver, kidneys and lymphatic system. Arsenic is also a carcinogen and an animal teratogen.

Asbestos is a recognized human carcinogen which produces chronic lung disease (asbestosis) and cancer of the lungs, stomach, colon and rectum in exposed individual. The onset of asbestosis is likely controlled by duration of exposure to asbestos fiber, asbestos type, fiber morphology, and possibly individual susceptibility. This disorder is characterized primarily by fibrosis and calcification of lung tissue and may take from 20 to 40 years to develop, or may evolve in as little as 9 years.

Asbestos fibers have been detected in RCW drift from the X-633 cooling towers. Asbestos in RCW drift will be assessed prior to and during RFI activities in the X-633 area to facilitate the selection of appropriate protective ensembles.

Sodium acid sulfate and sulfuric, nitric, chromic and hydrochloric acid are a principal constituents of cleaning and plating solutions used in the X-700 chemical cleaning facility and X-720 maintenance building. Spent acidic cleaning and plating fluids from these units were discharged to the X-701C and X-720 neutralization pits for pH adjustment. Subsurface process lines were used to transfer spent chromic acid cleaning solutions and raffinate (uranium contaminated nitric acid) from these units to treatment or to the X-701B holding pond. Caustic rinse solutions and organic compounds comprised a portion of these waste streams.

The acids comprising the spent cleaning solutions are collectively severe eye, respiratory, and skin irritants, with damage varying according the length of exposure/contact and acid concentrations. Acid vapors and mist can erode exposed teeth and can produce serious respiratory damage characterized by pulmonary edema, dryness of mouth and throat, cough, and pneumonitis. Upon exposure to air nitric acid generates nitric oxide and nitrogen dioxide, which produces similar, serious, respiratory system damage. Exposure to chromic acid vapor may result in symptoms of hexavalent chromium toxicity and an elevated concentration of chromium in the body. Skin or eye contact with acid solutions may produce severe damage up to and including blindness.

Sodium hydroxide (caustic) solid or concentrated solutions will produce severe burns of the eyes and skin, resulting in scarring, corneal ulceration and opacification. Inhalation of sodium hydroxide may result in respiratory tract irritation or, in high concentration, pneumonitis.

Mercury generally produces damage to the central nervous system and kidneys; acute toxic concentrations may produce severe respiratory damage. Inhalation of (aryl) mercury vapor may produce weakness, anorexia, fatigue, and gastrointestinal distress. Elevated concentrations produce localized and whole-body tremors, behavioral changes, insomnia and loss of memory. Ingestion of mercury salts produce gastrointestinal damage, renal failure, and possibly circulatory system collapse. Alkyl mercury poisoning via inhalation, ingestion or skin absorption produces a host of symptoms including numbness of tingling of lips, hands and feet, hearing impairment, spastic jerking of limbs, nausea, vomiting, etc. Mercury is a proven human teratogen.

Mercury may be present in effluents discharged into the X-720 neutralization pit. Personal protective equipment to be employed by RFI investigation personnel will afford dermal protection against mercury. Due to the relatively low intensity of investigative activities, and nature of potential releases, airborne concentrations of mercury should not be encountered.

Strychnine is a toxic substance which upon ingestion or inhalation produces stiffness of the face and neck muscles, exaggerated muscular reaction to external stimuli, convulsions, and possibly death. Death result primarily from anoxia, as evidenced by the onset of cyanosis (blue discoloration to the lips and fingertips).

Strychnine may be present in effluents discharged from the X-720 maintenance building and neutralization pit. Protective equipment specified for X-720 RFI activities will afford protection against strychnine exposure.

3.2.4 Physical Hazards

Physical hazards associated with drilling and sampling activities are seen as presenting an equal or greater potential for injury than chemical exposure. These are posed by heavy equipment, trenches, electric shock, unseen obstacles, noise, heat stress, hypothermia, poor illumination, and bodies of water.

Injuries which may result from physical hazards existing on a work site include;

- Slip-trip-fall type of accidents;
- Back injuries due to improper lifting;

- Casualties resulting from being caught in moving or rotating drilling equipment;
- Electrocution hazards associated with drill rig mobilization; i.e., contact with overhead/underground power lines;
- Operation of improperly maintained equipment.

Injuries resulting from physical hazards can be avoided through the adoption of safe work practices and employing caution when working with machinery. Safe work practices to be employed during Quadrant II RFI activities are described in Section 8.5. To ensure a safe workplace, the HSO will conduct and document regular safety inspections. The HSO will ensure that all workers are informed of any physical hazards related to the site.

4.0 EMPLOYEE TRAINING REQUIREMENTS

All Geraghty & Miller personnel, subcontractors, and others who will participate in Quadrant II RFI field activities will be required to meet the minimum training requirements outlined in OSHA standard 29 CFR 1910.120 covering Hazardous Waste Operations and Emergency Response. These requirements specify:

- Forty hours of initial training consisting of classroom and hands-on experience in the use of personal protective equipment (PPE), safe operating practices, identification of potential hazards or hazardous situations, etc., in accordance with the OSHA standard or 24 hours of training for workers on-site for specific tasks (surveyors, etc.);
- Eight hours of annual refresher training in addition to the initial 40-hour training program for all personnel;
- Eight hours of specialized supervisory training for personnel serving as supervisory staff;
- Three days' of work activity under the supervision of a trained and experienced supervisor, for new employees.

Documentation confirming these requirements (training certificates, training rosters, etc.) will be obtained by the HSO and retained at the command post for reference.

Prior to startup of Quadrant II RFI field activities, a pre-program briefing will be presented to all field personnel and subcontractors by the Health and Safety Coordinator and MMES health and safety specialists. The following topics will be addressed during the pre-program briefing:

- Names of the HSO and the designated alternate;
- Site history;
- Hazardous substances which may be encountered during RFI field activities, including their properties and symptoms of exposure as well as location of Material Safety Data Sheets;
- Work tasks to be performed;
- Use and maintenance of environmental surveillance equipment;
- Action levels and identification of situations which require an upgrade or downgrade in levels of protection;
- Level of protection to be employed for work area tasks, including use, operation, limitations and maintenance of respiratory protection;
- Site control measures, including safe operating practices, communication, etc.;
- Physical hazards which may be encountered;
- Training requirements;
- MMES plant requirements, procedures, and prohibitions;
- Decontamination procedures, including a hands-on exercise of decontamination procedures;
- Confined space entry procedures, if applicable;
- Personnel exposure emergency procedure (skin contact, inhalation, ingestion, falls etc): Notify Safety Office (or Shift Superintendent at ext. 3025);
- Potential or actual fire or explosion emergency procedure: Call emergency #5555. Relate location and status of the fire or explosion and injuries to personnel. Response will be immediate;
- Potential or actual ionizing radiation exposure emergency procedures: Notify the HSO of suspected or actual exposure to ionizing radiation (e.g., ingestion of uranium particulate). The HSO will respond by notifying either the Shift Superintendent or Health Physics personnel as the situation warrants;

- Environmental accidents emergency procedure (spread of contamination outside exclusion zone): Call Shift Superintendent at ext. 3025 and relate incident. The Shift Superintendent or his representative will be the authority at the site of the incident;
- Emergency signals and/or codes: (see Sections 11 and 12 of the GHASP for a description of emergency alarms);
- Emergency routes: (this will depend upon worksite location);
- Emergency phone number: 5555.

Any other health and safety-related topics which may arise prior to RFI startup will also be discussed at the preprogram briefing.

Issues which may arise during implementation of the Quadrant II RFI field program will be addressed during "tailgate" safety meetings, which are to be held approximately daily, prior to shift startup. Any changes in procedures or site-specific health and safety-related matters will be addressed during these meetings. New, untried sampling methods to be employed within the exclusion zone will be rehearsed prior to implementation.

5.0 PERSONAL PROTECTION REQUIREMENTS

Personal protective equipment (PPE) will be worn to protect field personnel from known or suspected atmospheric, soil, or water-borne contamination. The levels of personal protection to be employed for Quadrant II RFI work tasks have been selected based upon known or anticipated concentrations of contaminants which may be encountered, their chemical properties, toxicity, exposure routes, and contaminant matrix.

5.1 PPE Ensembles

Four generally accepted levels of protection developed by the USEPA are described below. Each level is categorized according to the degree of protection afforded by the ensemble of PPE designated for each level. These four levels, and necessary PPE components, are as follows:

- **LEVEL A:**

Level A protection should be employed when the highest level of respiratory, skin and eye protection is needed. Level A PPE ensemble generally consists of the following:

Supplied air respirator (airline respirator with escape bottle) or Self-Contained Breathing Apparatus (SCBA) approved by the National Institute for Occupational Safety and Health (NIOSH). Respirators shall be positive-pressure demand-type;

- Fully encapsulating chemical-resistant suit;
- Work clothes;
- Gloves (inner), chemical-resistant;
- Boots, chemical-resistant, steel toe and shank;
- Hard hat (inside suit);
- Disposable gloves and boot covers (worn over fully encapsulating suit);
- Cooling unit;
- 2-way radio (intrinsically safe).

• LEVEL B:

Level B should be used when the highest level of respiratory protection is required, but a lesser level of skin protection is warranted. Level B PPE generally consist of the following:

- Supplied air respirator (airline respirator with escape bottle) or Self-Contained Breathing Apparatus (SCBA) approved by the National Institute for Occupational Safety and Health (NIOSH). Respirators shall be positive-pressure demand-type;
- Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one or two piece chemical-splash suit; disposable chemical-resistant, one piece suits);
- Work clothes;
- Gloves (outer), chemical-resistant;
- Gloves (inner), chemical-resistant;
- Boots (outer), chemical-resistant (disposable);
- Hard hat (face shield);
- 2-way radio (intrinsically safe).

• LEVEL C:

Level C protection should only be worn when all of the criteria for air-purifying respiratory protection are satisfied, and the potential for dermal absorption or damage is limited or nonexistent. A level C ensemble generally consists of:

- Air-purifying respirator, full-face, cartridge-equipped (NIOSH approved);
- Chemical-resistant clothing (coveralls; hooded, one-piece or two-piece chemical splash suit; chemical-resistant hood and apron; disposable chemical-resistant coveralls);
- Work clothes;
- Gloves (outer), chemical-resistant;
- Gloves (inner), chemical-resistant;
- Boots (outer), chemical-resistant, steel toe and shank;
- Boot covers (outer), chemical-resistant (disposable);
- Hard hat (face shield);
- Escape mask.

• LEVEL D:

Level D PPE consist basically of a work uniform to be worn in areas with no skin, or respiratory hazards. A representative level D ensemble includes:

- Coveralls;
- Gloves;

- Boots/shoes, leather or chemical-resistant, steel toe and shank;
- Chemical resistant outer boots;
- Safety glasses or chemical splash goggles;
- Hard hat.

Protection levels may be upgraded, downgraded, or modified as deemed necessary by the HSO or his designee, based upon work task or site-specific, safety-related factors, such as:

- When noise levels exceed 85 dBA, hearing protection is required;
- Change in work tasks within a work area/exclusion zone; or work that begins on a different portion of the site;
- Change of season/weather;
- When temperature extremes or individual medical considerations (i.e., heat stress, medication, etc.) limit the effectiveness of PPE;
- Contaminants other than those previously identified are encountered;
- Change in ambient levels of contaminants;
- Change in work space which effects the degree of contact with contaminants.

5.2 Duration of Work Tasks

The duration of field activities involving the usage of PPE will be established by the HSO or his designee based upon ambient temperature and weather conditions, the capacity of personnel to work in the designated level of PPE (heat stress and cold stress;

see Environmental Surveillance, Section 7), and limitations of the protective equipment, i.e., ensemble permeation rates, life expectancy of air-purifying respirator cartridges, SCBA air supply consumption, etc.

As a minimum, rest breaks will be observed at the following intervals:

- Fifteen minutes midway between shift startup and lunch;
- One-half to one hour for lunch; and
- Fifteen minutes in the afternoon, between lunch and shift end.

All rest breaks will be taken in a clean area (e.g. support zone), after full decontamination and PPE removal. Additional rest breaks will be observed, based upon the heat stress monitoring guidelines presented in Section 7.5.

5.3 Designated Levels of Protection

The following general levels of protection and associated PPE ensemble have been selected for use by field personnel for work tasks, as outlined on Table 5.1.

LEVELS OF PERSONAL PROTECTION TO BE EMPLOYED
DURING QUADRANT II RFI WORK TASKS

MMES UNIT NUMBER	UNIT NAME	SOIL BORINGS WITH SAMPLING	MONITORING WELL INSTALLATION	BASIN/PIT/ POND SEDIMENT SAMPLING	STREAM/DITCH/ SEDIMENT SAMPLING	SURFACE-WATER SAMPLING	GROUND-WATER ⁽¹⁾ SAMPLING	TANK SAMPLING	TEST PIT INVESTIGATION
X-2300J7	East Holding Pond Oil Separation Basin			Cm ⁽³⁾					
X-633	RCW Pump House and Cooling Towers	C ⁽²⁾	C ⁽²⁾				C ⁽²⁾		
X-700	TCE/TCA Storage Tanks	Cm							
X-700	Chemical Cleaning Facility	Cm	Cm				Cm		
X-700	Chemical and Petroleum Storage Tanks	Cm							Cm ⁽³⁾
X-701	N.E. Biodegradation Plots	Cm ⁽³⁾							
X-701C	Neutralization Pit	Cm ⁽³⁾	Cm ⁽³⁾				Cm ⁽³⁾		
X-705	Decontamination Building	Cm ⁽³⁾	Cm ⁽³⁾				Cm ⁽³⁾		
X-705	Radioactive Waste Incinerator	C ⁽³⁾							
X-795 B	Burnable Storage Lot	C ⁽³⁾							
X-720	Maintenance and Storage Building	Cm ⁽³⁾	Cm ⁽³⁾				Cm ⁽³⁾		
X-720	Neutralization Pit			B ⁽³⁾					
X-744G	Bulk Storage Building	Cm							
X-744	Retrievable Waste Storage Area	Cm							
	East Drainage Ditch and Little Beaver Creek	Dm			Dm	Dm			

Notes:

B = Full Level B

Cm = Modified level C (see Section 5.3)

Dm = Modified level D (see Section 5.3)

C = Full level C (typical)

D = Full level D (typical)

- (1) Selection of protective garment will be determined by HSO based upon presence/absence of contaminants during drilling and well installation.
- (2) Requirement for air-purifying respirators will be dependent upon results of background air monitoring for hexavalent chrome and arsenic.
- (3) Protective garments will consist of poly-coated or PVC-coated Tyvek coveralls or saranex

**LEVELS OF PERSONAL PROTECTION TO BE EMPLOYED
DURING QUADRANT II RFI WORK TASKS**

MMES UNIT NUMBER	UNIT NAME	SOIL BORINGS WITH SAMPLING	MONITORING WELL INSTALLATION	BASIN/PIT POND SEDIMENT SAMPLING	STREAM/DITCH/ SEDIMENT SAMPLING	SURFACE-WATER SAMPLING	GROUND-WATER ⁽¹⁾ SAMPLING	TANK SAMPLING	TEST PIT INVESTIGATION
X-700 to X-705	Process Lines	Cm							Cm
	Sanitary Sewer System	Cm							
X-614P	N.E. Sewage Lift Station	Cm							
	Storm Sewers D&E	Cm							

Notes:

B = Full Level B
 Cm = Modified level C (see Section 5.3)
 Dm = Modified level D (see Section 5.3)
 C = Full level C (typical)
 D = Full level D (typical)

- (1) Selection of protective garment will be determined by HSO based upon presence/absence of contaminants during drilling and well installation.
- (2) Requirement for air-purifying respirators will be dependent upon results of background air monitoring for hexavalent chrome and arsenic.
- (3) Protective garments will consist of poly-coated or PVC-coated Tyvek coveralls or saranex

- Level C (Modified):

- Chemical-resistant clothing (one-piece Tyvek coverall, requirement for hood to be determined; one or two-piece chemical splash suit; Saranex coveralls). Selection of garment to be based upon site conditions and work task, see Table 5.1;
- Gloves; outer (Neoprene);
- Gloves; inner (skin-tight Latex);
- Boots; chemical resistant to substances of concern, steel toe and shank;
- Hard hat (face shield optional);
- Chemical safety goggles, if not wearing respirator;
- Air-purifying respirator, full-face, cartridge-equipped; see Section 5.5, need for respirator to be determined by work area monitoring;
- Sleeves will be taped to gloves, and cuffs taped to boots, as applicable.

- Level D (Modified):

- Chemical-resistant clothing (one-piece Tyvek coverall);
- Boots; chemical resistant to substances of concern, steel toe and shank;
- Gloves; outer (Nitrile);
- Safety glasses.

5.4 Limitations of Protective Clothing

PPE ensembles designated for use during RFI work tasks have been selected to provide protection against contaminants at known or anticipated concentrations in soil or water matrices. However, no protective garment, glove, or boot is chemical-proof, nor will

it afford protection against all chemical types. Permeation of a given chemical through PPE is a complex process governed by contaminant concentrations, environmental conditions, physical condition of the protective garment and the resistance of a garment to a specific contaminant; chemical permeation may continue even after the source of contamination has been removed from the garment.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all site personnel using PPE:

- When using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift;
- Inspect all clothing, gloves, and boots both prior to and during use for:
 - Imperfect seams;
 - Non-uniform coatings;
 - Tears;
 - Poorly functioning closures
- Inspect reusable garments, boots and gloves both prior to and during use for:
 - Visible signs of chemical permeation:
 - Swelling;
 - Discoloration;
 - Stiffness;
 - Brittleness.
 - Cracks;
 - Any sign of puncture; and
 - Any sign of abrasion.

Reusable gloves, boots or coveralls exhibiting any of the characteristics listed above will be discarded. PPE used in areas known or suspected to exhibit elevated concentrations of contaminants will not be reused.

5.5 Respirator Selection, Use, and Maintenance

The following air-purifying respirators have been selected for use, when required, during the Quadrant II RFI field program:

- Full-face, air-purifying respirator equipped with organic vapor/acid gas/highly toxic particulate-absorbing cartridges (color coded magenta over yellow).
- Airline (supplied air) respirator operated in the pressure-demand mode and equipped with an escape bottle providing at least five minutes' supply of air.
- Self-Contained Breathing Apparatus operated in the pressure-demand mode (PD-SCBA).

Respirators have been selected based upon the substances which may be present and the concentrations of those compounds previously encountered at PORTS. The selection of respiratory protection will be performed by the HSO, in accordance with the guidelines for respiratory protection outlined in Section 7.

Air-purifying respirators are to be used only in conjunction with breathing space air monitoring, with strict adherence to the action limits as outlined in Section 7. Air-purifying respirators may only be used when the device affords protection

from the substances being encountered. If an air-purifying respirator cannot provide protection against all substances present at concentrations exceeding the action level, upgrading of respiratory protection to require SCBAs or air-line respirators will be required.

Other limitations which preclude the use of air-purifying respirators are:

- Oxygen-deficient atmosphere (less than 19.5 percent oxygen);
- Concentrations of substances which may be immediately dangerous to life and health (IDLH);
- Entry into confined or unventilated areas which may contain airborne contaminants that have not been characterized;
- Unknown contaminant concentrations or concentrations which exceed designated maximum use levels (see guidelines in Section 7);
- Presence of unidentified contaminants;
- High relative humidity (reduces sorbent life);
- Identified substances which have inadequate warning properties and sorbent service life is unknown and the unit has no end-of-service-life indicator.

All G&M and subcontractor personnel who will be taking part in the Quadrant II RFI will be required to provide evidence at the start of the field program that they have completed the training and health monitoring requirements of OSHA 29 CFR 1910.120 including a physician's letter stating that the employee is capable of wearing a respirator. G&M and subcontractor personnel

will be briefed on the proper use, maintenance, and limitations of air-purifying respirators during the pre-project briefing. G&M will also provide a qualitative respiratory fit test to assure the proper fit of the device. Results of the qualitative fit test of field personnel will be recorded by the HSO, along with documentation of the respiratory protection briefing.

Respirators issued to individuals will be cleaned and disinfected at least daily, if used. Where respirators are used by more than one person, the respirator will be cleaned and disinfected after each use. Respirators will be inspected during cleaning, and any necessary repairs will be made at that time. Damaged respirators will not be worn. After cleaning, respirators will be placed in clean, plastic bags and stored in a clean location convenient to the work areas. The following representative respirator cleaning and inspection procedures are to be used during the Quadrant II RFI:

- Daily Cleaning Procedures:

Respirator Disassembly. Respirators are taken to a clean location where the cartridges are removed, damaged to prevent accidental reuse, and discarded. For thorough cleaning, the inhalation and exhalation valves, speaking diaphragm, and any hoses are removed;

- **Cleaning.** In most instances, the cleaning and disinfecting solution provided by the manufacturer is used, and is dissolved in warm water in a appropriate tub. Using gloves, the respirator is placed in the tub and swirled for a few moments. A soft brush may be used to facilitate cleaning;
- **Rinsing.** The cleaned and disinfected respirators are rinsed thoroughly in water to removed all traces of detergent and disinfectant. This is very important for preventing dermatitis;
- **Drying.** The respirators may be allowed to dry in room air on a clean surface. They may also be hung upside-down like drying clothes, but care must be taken not to damage or distort the facepieces;
- **Reassembly and Inspection.** The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. Special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of exhalation valve, and can cause valve leakage or sticking.
- **After Routine Use in Exclusion Zone:**
 - The mask may be washed/rinsed with soap and water;
 - At a minimum, the mask should be wiped with disinfectant wipes (benzoalkaloid or isopropyl alcohol), and allowed to air dry in a clean area.
- **Air-Purifying Respirator Inspection and Checkout:**
 - Visually inspect the entire unit for any obvious damages, defects, or deteriorated rubber;
 - Make sure that the facepiece harness is not damaged;
 - Inspect lens for damage and proper seal in facepiece;
 - Exhalation Valve - pull off plastic cover and check valve for debris or for tears in the neoprene valve (which could cause leakage);

- Inhalation Valves (two) - screw off cartridges and visually inspect neoprene valves for tears. Make sure that the inhalation valves and cartridge receptacle gaskets are in place;
- Make sure a protective cover lens is attached to the lens;
- Make sure the speaking diaphragm retainer ring is hand tight;
- Don and perform negative pressure test.

The effectiveness of the respiratory protection program will be continuously monitored by the HSO or his designee. Monitoring of worker stress levels during activities which require respiratory protection will also be performed by the HSO or his designee (see Section 7 Environmental Surveillance).

Should upgrading to level B (supplied-air systems) be required, all previously described requirements for the use and maintenance of respirators will continue to be enforced. In addition, the requirements for breathing quality air outlined in OSHA 29 CFR 1910.134 will be met.

In the unlikely occurrence that supplied air systems are required for RFI activities, backup personnel equipped with self contained breathing apparatus will also be present, as required by OSHA 29 CFR 1910.134.

6.0 MEDICAL SURVEILLANCE

6.1 Health Monitoring

All Geraghty & Miller and subcontractor personnel involved in RFI activities at PORTS will participate in a comprehensive health-monitoring program, as required by OSHA 29 CFR 1910.120(f). Geraghty & Miller has established a health monitoring program with occupational health specialists at the Plainview Medical Group. Under this program Geraghty & Miller personnel receive annual physicals consisting of the following:

The basic medical examination consists of the following:

- Personal, family, and environmental history;
- Hands-on physical examination;
- Snellen's eye examination;
- Pap smear (females over age 21);
- Hemoccult testing (over age 40);
- Laboratory test;
- Rectal examination;
- Audiometric screening;
- Tonometry (35 years of age and older);
- Pulmonary function testing;
- Resting electrocardiogram; and
- Chest-x-ray (once every 3 years).

A. Complete Blood Count:

- Red blood count;
- White blood count;
- Differential screening;
- Hemoglobin; and
- Hematocrit.

B. Urinalysis:

- . Sugar;
- . Albumin; and
- . Specific Gravity.

C. Laboratory Chemistries:

- . A/G Ratio;
- . Alkaline Phosphatase;
- . Bilirubin, Total;
- . Calcium;
- . Chloride;
- . Cholesterol;
- . Creatinine;
- . GGT;
- . Globulins;
- . Glucose;
- . Iron;
- . Lactic Dehydrogenase (LDH);
- . Phosphorus;
- . Potassium;
- . Protein, Total;
- . SGOT;
- . SGPT;
- . Sodium;
- . Triglycerides;
- . Urea Nitrogen (BUN);
- . Uric Acid; and
- . Serum PCBs.

Geraghty & Miller obtains and furnishes employees with a copy of a written opinion from the examining physician. This opinion includes the following (in accordance with 29 CFR 1910.120 (f) (6)):

- . The results of the medical examination and tests;
- . The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response;

- The physician's recommended limitations upon the employees' assigned work, with special emphasis on fitness for duty, including the ability to wear any required personal protective clothing and equipment under conditions (i.e., temperature extremes) that may be expected at the work site; and
- A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

All subcontracted employees are required to have equivalent health monitoring programs which comply with 29 CFR 1910.120(f).

6.2 Documentation and Record Keeping Requirements

The HSO will maintain at the command post a medical surveillance file containing a copy of the physicians written opinion and date of latest annual physical examination for each Geraghty & Miller and subcontractor employee performing RFI field activities. Any visitor or observer approved for entry into any work area will be required to provide the above documentation to the HSO prior to site entry.

Geraghty & Miller will be responsible for the recording and reporting of illnesses and injuries in accordance with DOE and OSHA requirements. Copies of these reports will be provided to Geraghty & Miller's medical surveillance files and the Portsmouth Facility's Safety Department personnel. Recordable occupational accidents and illnesses are those defined in DOE Order 5484.1A,

"Environmental Protection, Safety, and Health Protection Information Reporting Requirements" and OSHA 29 CFR 1910 and 1926.

The contractor will submit a DOE Form 5484.X, "Individual Accident/Incident Report" for each occurrence for which reporting is required under DOE 5484.1A. Forms will be submitted to the Portsmouth Facility's Safety Department and the cognizant DOE Operations Office. Additionally, the contractor should comply to all reporting requirements as identified in OSHA 29 CFR 1910 and 1926.

The contractor will notify the DOE Operations Office, PORTS Safety Department, and the Project Manager of a fatality or serious accident, as required in DOE Order 5484.1A. Fatal accidents will be investigated by the PORTS Safety Department and/or DOE representative s as the situation requires.

6.3 Medical Support and Follow-Up

Geraghty & Miller encourages its employees and subcontractor personnel to seek additional medical attention and physical testing as a follow-up to an injury or possible exposure above established exposure limits. Depending upon the type of exposure, follow-up testing should be performed within 24-48 hours of injury/exposure. The type of test to be performed to monitor for exposure effects will be based upon the contamination involved,

and will be selected by a qualified health professional of the Plainview Medical Group.

6.4 Bioassay Program - Internal Radiation Exposure Monitoring

All workers will submit baseline and exit bioassay urine samples for total U, gross alpha and Tc-99. The urine specimen will represent at least a full 24-hour period. The minimum acceptable volume for this baseline sample is 1.0 liter. Monthly specimens for the routine bioassay program will be collected on Friday or the last day of the workshift. Additional uranium bioassay samples will be collected whenever an intake above Plant Allowable Limits may have occurred (per PORTS GDP, SPP, H-34). Action limits for the bioassay program are provided in PORTS GDP Urinalysis Program Document, Section IV.

The purposes of the bioassay program are to confirm the results of the air sampling program and confirm the effectiveness of the respiratory protection program. All samples will be analyzed by PORTS laboratories.

6.5 Radiation Monitoring Badge - External Radiation Exposure Monitoring

All workers will wear a radiation monitoring badge provided by MMES. This badge utilizes TLD monitoring technology and provide an integrated measurement of external radiation dose

received during work at the PORTS site. These badges are to be left at the PORTS site at the end of each day and worn during all work activity onsite.

7.0 ENVIRONMENTAL SURVEILLANCE OF WORK AREAS

Air monitoring will be performed during certain designated Quadrant II RFI work tasks, in order to protect field personnel from exposure to air borne hazardous substances and health hazards and to determine appropriate levels of personal protective equipment for work tasks.

7.1 Initial Air Monitoring and Radiation Contamination Monitoring

Initial air monitoring and radioactive contamination monitoring of work areas/exclusion zones will be performed prior to startup of any work tasks. Initial air monitoring and radioactive contamination monitoring will be performed using real-time field survey instrumentation for the following parameters:

- Flammable atmospheres;
- Oxygen-deficient atmospheres;
- Levels of airborne organic contaminants;
- Ambient radiation levels; and
- Radioactive contamination levels.

These parameters will also be monitored at the beginning of each work day, to identify background contaminant concentrations and to monitor for any IDLH or other potentially hazardous situation which could develop during off-shift periods.

7.2 Periodic Air Monitoring

Air monitoring will be performed on a periodic basis during field activities, as outlined in Table 7.1. Periodic monitoring will be performed as a minimum when:

- Work begins on a different portion of the site;
- Contaminants other than those previously identified are being handled;
- A different type of operation is initiated (e.g., drum openings as opposed to exploratory well drilling); and when
- Employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

Field survey instruments and sampling/monitoring intervals to be employed during work tasks in work areas are summarized in Section 7.3.

Since mixtures of VOCs may be encountered, and real-time field survey instrumentation may react to the total VOC mixture (positive interference, or false-positive readings), individual concentrations of VOCs of concern will likely not be determined by these instruments. For situations involving exclusively positive interference and pending analysis of personal air samples, as

TABLE 7.1
ENVIRONMENTAL SURVEILLANCE MONITORING TO BE PERFORMED DURING QUADRANT II RFI FIELD ACTIVITIES

MMES UNIT NUMBER	UNIT NAME	SOIL BORING WITH SAMPLING	MONITORING WELL INSTALLATION	BASIN/PIT POND SEDIMENT SAMPLING	STREAM/DITCH SEDIMENT SAMPLING	SURFACE- WATER SAMPLING	GROUND- WATER SAMPLING	TANK SAMPLING	TEST PIT INVESTIGATION
X-230J7	East Holding Pond Oil Separation Basin			R PID PSD					
X-633	RCW Pumphouse and Cooling Towers	R PID I	R PID I				R PID I		
X-700	Chemical Cleaning Facility	R PID PSD	R PID PSD				R PID		
X-700	TCE/TCA Storage Tanks	R PID PSD							
X-700	Chemical And Petroleum Storage Tanks	R PID PSD						R PID PSD C O	
X-701	N.E. Biodegradation Plots	R PID PSD							
X-701C	Neutralization Pit	R PID PSD C	R PID PSD				R PID		
X-705	Decontamination Building	R PID PSD	R PID PSD				R PID		
X-705A	Radioactive Waste Incinerator	R PID							
X-705B	Burnable Storage Lot	R PID							
X-720	Maintenance and Stores Building	R PID PSD CN	R PID PSD CN				R PID CN		
X-720	Neutralization Pit			R PID PSD C O CN					
X-744G	Bulk Storage Building	R PID PSD							

Monitoring Parameters:

C: Combustible Gas Measurements

O: Oxygen Deficiency

R: Radionuclides

I: Inorganics - Personal Air Sampling Device

CN: Hydrogen Cyanide Detector

PID: Organic Vapors - Photoionization Detector

PSD: Organic Vapors - Personal Air Sampling Device

Note: Radiation monitoring badges will be worn by all personnel working at the PORTS site during all work tasks.

TABLE 7.1 (cont.)
ENVIRONMENTAL SURVEILLANCE MONITORING TO BE PERFORMED DURING QUADRANT II RFI FIELD ACTIVITIES

MMES UNIT NUMBER	UNIT NAME	SOIL BORING WITH SAMPLING	MONITORING WELL INSTALLATION	BASIN/PIT POND SEDIMENT SAMPLING	STREAM/DITCH DITCH SEDIMENT SAMPLING	SURFACE WATER SAMPLING	GROUND WATER SAMPLING	TANK SAMPLING	TEST PIT INVESTIGATION
X-744	Retrievable Waste Storage Area	R							
	East Drainage Ditch and Little Beaver Creek	R PID PSD			R PID	R			
X-700 to X-705	Process Lines	R PID PSD							R PID PSD CO
	Sanitary Sewer System	R PID PSD C							
X-614P	Northeast Sewage Lift Station	R PID PSD C							
	Storm Sewers D and E	R PID PSD							

Monitoring Parameters:

C: Combustible Gas Measurements

O: Oxygen Deficiency

R: Radionuclides

I: Inorganics - Personal Air Sampling Device

CN: Hydrogen Cyanide Detector

PID: Organic Vapors - Photoionization Detector

PSD: Organic Vapors - Personal Air Sampling Device

Note: Radiation monitoring badges will be worn by all personnel working at the PORTS site during all work tasks.

described below, it will be assumed that any VOC mixture detected will be made up entirely of the VOC with the lowest airborne exposure limit. This means that the lower applicable values of the American Conference of Governmental and Industrial Hygienists (ACGIH) threshold limit values (TLVs) or OSHA permissible exposure levels (PELs) for the volatile organic substances described in Section 3.0 will be used to establish the measured atmospheric concentrations at which respiratory protection levels will be changed (increased or decreased). Action levels are described in Section 7.3. Direct readings instruments will not be used to monitor for substances which cannot be detected (or be poorly detected) by the field survey instrument (false-negative response, or negative interference).

Once site characterization activities have commenced, monitoring will be conducted to quantitatively characterize employee exposure. This monitoring will be conducted on those employees likely to have the highest potential exposure to those hazardous substances and health hazards most likely to be present above established permissible exposure limits (i.e., drillers, ground-water sampling personnel, etc.). Those chemicals selected for employee-exposure monitoring (see Table 7.2) have been chosen based upon findings of previous investigation and the review of existing conditions for each unit.

Note:

Table 7.2 is being revised to include additional compounds listed in Table 3.2. The updated version will be sent upon completion.

TABLE 7.2

PERSONAL AIR SAMPLING PROGRAM: ANALYTICAL
PARAMETERS, SAMPLING METHODS AND ANALYTICAL TECHNIQUE

CONTAMINANT	NIOSH SAMPLING NO.	COLLECTION MEDIUM	ANALYTICAL TECHNIQUE
Cupric Arsenate (as As)	173	37 mm Mixed Cellulose Ester (MCE)	AAS (Graphite Furnace)
Chrome, Hexavalent (as Cr)	173	37 mm MCE	AAS-(Flame)
Zinc (as Zn)	173	37 mm MCE	AAS-(Flame)
Trichloroethylene	1022	Charcoal	CS ₂ Extraction GC/FID
1,1-Dichloroethane	1003	Charcoal	CS ₂ Extraction GC/FID
1,1-Dichloroethylene	1015	Charcoal	CS ₂ Extraction GC/FID
1,1,1-Trichloroethane	1003	Charcoal	CS ₂ Extraction GC/FID
Trans-1,2 Dichloroethylene Extraction		1003	Charcoal CS ₂ GC/FID
Methylene Chloride	1005	Charcoal	CS ₂ Extraction GC/FID
Chloroform	1003	Charcoal	CS ₂ Extraction GC/FID
Carbon Tetrachloride	1003	Charcoal	CS ₂ Extraction GC/FID
1,1,2-Trichloroethane	1003	Charcoal	CS ₂ Extraction GC/FID
Benzene	1500-1501	Charcoal	CS ₂ Extraction GC/FID
Toluene	1500-1501	Charcoal	CS ₂ Extraction GC/FID
Xylene	1501	Charcoal	CS ₂ Extraction GC/FID
Ethylbenzene	1501	Charcoal	CS ₂ Extraction GC/FID

TABLE 7.2 (cont.)

PERSONAL AIR SAMPLING PROGRAM: ANALYTICAL
PARAMETERS, SAMPLING METHODS AND ANALYTICAL TECHNIQUE

CONTAMINANT	NIOSH SAMPLING NO.	COLLECTION MEDIUM	ANALYTICAL TECHNIQUE
Nitric Acid Aerosols	4 (S 319)	Deionized H ₂ O Impinger	Specification Electrode
Sulfuric Acid Aerosols	1 (187)	Deionized H ₂ O Impinger	Colorimetry
Chromic Acid Aerosols	7600	Deionized H ₂ O Impinger	Colorimetry
Asbestos	7402 or USEPA Level 2 TEM	25mm MCE	TEM
Radioactivity, Contamination			
Gross Alpha	--	37 mm MCE	Alpha/Beta Proportional Counter
Gross Beta	--	37 mm MCE	Alpha/Beta Proportional Counter

Note:

AAS: Atomic Absorption Analysis

GC/FID: Gas Chromatograph with Flame Ionization Detector

TLD Badge: Thermoluminescent Detector Badge

TEM: Transmission Electron Microscopy

7.3 Monitoring Parameters and Survey Instrumentation

Air monitoring parameters, detection devices, and action levels are presented below. Air monitoring for VOCs will be performed at shoulder height (in the breathing zone) on those workers most likely to be exposed to potentially hazardous concentrations of contaminants, and around the borehole or well. Monitoring of percent oxygen and combustible atmosphere will be conducted at waist height and near the ground surface (to determine the presence and accumulation of heavier-than-air gasses). Radiation levels will be monitored at waist level and radioactive contamination levels at the surface of drill cuttings or equipment to determine whether radioactive solids are present.

- Explosive Atmospheres:

- Instrument:

- Combustible Gas Indicator

- Sampling Frequency:

- Start-of shift;
 - Four times daily; twice in morning, twice in afternoon.

- Action Level-Action:

- <10% LEL Continue investigation;
 - 10%-25% LEL Continue on-site monitoring with extreme caution as higher levels are encountered;
 - >25% LEL Explosion hazard. Withdraw from area immediately.

- Percent Oxygen:

- Instrument:

- Percent Oxygen Sensor

Sampling Frequency:

- Start of Shift;
- Four times daily; twice in morning, twice in afternoon.

Action Level-Action:

- <19.5% Monitor wearing self-contained breathing apparatus. NOTE: Combustible gas readings are not valid in atmosphere with <19.5% oxygen;
- 19.5%-25% Continue investigation with caution. Deviation from normal level may be due to presence of other substances;
- >25% Fire hazard potential. Discontinue investigation. Consult a fire safety specialist.

Radiation:

Instrument:

- Mini CONRAD II
 - Gamma Radiation;
 - Alpha; surface contamination; exclusion zone;
 - Beta; surface contamination; exclusion zone.
- Ludlum Model 12 with pancake detector Ludlum Model with ZnS scintillation Detector
 - Decontamination of equipment;
 - Frisking of personnel after decontamination;
 - Alpha: surface contaminants;
 - Beta: surface contaminants.

Sampling Frequency:

- Continuously during field activities;
 - Drill cuttings;
 - Sampling equipment;
 - Ambient radiation levels.

Action Level-Action:

- Gamma Radiation:
 - ≤ 2 mrem/hr: Radiation above environmental and instrument background levels (normally 0.01-0.02 mrem/hr) signifies the possible presence of radiation sources. Continue investigation with caution. Perform thorough monitoring. Consult with a health physicist.
 - > 2 mrem/hr: Potential radiation source. Proceed only upon the advice of a health physicist. Notify MMES Health Physics Department immediately.

Alpha and Beta Radiation:

At first evidence of any alpha or beta radiation above release levels (see Table 9.1 for release levels): Potential radiation source. Proceed only upon advice of a health physicist. Notify MMES health physics department immediately. MMES personnel will perform contamination monitoring; recommend protective equipment based on contamination levels and tasks to be performed; provide Personal Air Sampling Device (PASD) for quantification of air-borne radioactivity (samples to be analyzed by MMES). See Table 7.3.

Organic Vapors:

Instrument

- Ultraviolet Photoionization Detector (PID) Photovac TIP II
- Personal Air Sampling Device with laboratory quantitation (PASD); see Table 7.2

Sampling Frequency:

- Start-of-shift (PID);
- Continuously during work task performance (PID);
- Once per week during specified work task (PASD);
- During activities in areas of suspected high exposure hazard (PASD).

Action Level-Action:

- \leq 1ppm via PID: Continue investigation under modified level C; continue monitoring;
- 1 ppm-25 ppm: Notify SSO. Upgrade to full level C; continue monitoring;
- $>$ 25 ppm: Evacuate area and notify SSO. If concentrations do not drop below 25 ppm within $\frac{1}{2}$ hour, upgrade to level B protection (based upon OSHA PEL for 1,1-dichloroethylene)

Inorganic Vapors and Particulate (X-633 area only):

Instrument:

- Personal Air Sampling Device (PASD) with laboratory quantitation; see Table 7.2.

Sampling Frequency:

- Prior to activities within area of recirculating cooling water (RCW) drift;
- Once per week during work task execution.

TABLE 7.3

RESPIRATORY PROTECTION GUIDELINES ALPHA RADIATION

<u>RANGE</u> <u>(dpm/100 cm²)</u>	<u>RESPIRATORY</u> <u>PROTECTIVE</u> <u>EQUIPMENT</u>
Based on Surface Reading	
0 to 5,000	None
5,000 to 620,00	FFAPR
620,000 to 24,000,000	SAR-PD
24,000,000 to 124,000,000	SCBA-PD
Greater than 124,000,000	No entry
Based on Wipe Reading	
0 to 1,000	None
1,000 to 200,000	FFAPR
200,000 to 8,000,000	SAR-PD
8,000,000 to 40,000,000	No Entry

TECHNETIUM AND URANIUM DAUGHTER BETA RADIATION EMITTERS

Based on Surface Reading	
0 to 200,000	None
200,000 to 50,000,000	FFAPR
Greater than 50,000,000	No Entry
Based on Wipe Reading	
0 to 40,000	None
40,000 to 10,000,000	FFAPR
Greater than 10,000,000	No Entry

FFAPR: Full-face air purifying respirator

SAR-PD: Airline respirator-pressure demand mode

SCBA-PD: Self-Contained Breathing Apparatus-pressure demand mode

dpm/100cm²: disintegrations per minute per 100 square centimeters

Note: When respiratory protection is required, FFAPR shall be the minimum protection worn.

- Action Level-Action:
 - Respiratory protection level will be determined by preliminary air sampling.
- Hydrogen Cyanide (X-720 neutralization pit)
 - Instrument:
 - Monitox HCN Detector.
 - Sampling Frequency:
 - Continuously during sampling of X-720 neutralization pit.
 - Action Level-Action:
 - Level B protection specified; background monitoring only.
- Acid Gases (X-720 neutralization pit):
 - Instrument:
 - Personal Air Sampling Device (PASD) with laboratory quantitation; see Table 7.2
 - Sampling Frequency:
 - Once during sampling activities.
 - Action Level-Action:
 - Level B protection specified, monitoring only for background levels.
- Asbestos (X-633 area only):
 - Instrument:
 - Personal Air Sampling Device (PASD) with laboratory quantitation; see Table 7.2.
 - Sampling frequency:
 - Prior to activities within area of recirculating cooling water (RCW) drift;
 - Once per week during work task execution
 - Action Level-Action:
 - Respiratory protection level will be determined by preliminary air sampling.

The results of all atmospheric monitoring will be recorded on specially-prepared environmental surveillance sampling logs, along with any action taken by the HSO.

7.4 Use and Maintenance of Survey Instrumentation

All personnel who will be using field survey meters or personal air sampling devices will be thoroughly briefed on the operation, limitations and maintenance of these devices. All maintenance and calibration procedures will be in strict accordance with the manufacture's guidelines by a designated individual familiar with the devices. Any repairs, maintenance or routine calibration of these devices will be recorded in an equipment maintenance logbook which shall be signed by the servicing technician.

7.5 Heat Stress Monitoring

Heat stress is probably one of the most common and more serious of illnesses occurring at hazardous waste sites. Heat stress is caused by several interacting factors such as environmental conditions, clothing, workload, physical condition and characteristics of the employee, and the type of PPE required for the work task. Dependent upon the type of PPE worn, this equipment can add considerable weight, increase the body's

expenditure of energy, and reduce the body's normal heat-exchange mechanisms.

Heat stress may be of concern especially when the dry-bulb air temperature exceeds 70°F. The following control measures shall be used to help control heat stress if ambient temperatures above 70°F are expected:

- Provisions of adequate liquids to replace lost body fluids. Employees must replace water and salt lost from sweating. Employees must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement;
- Replacement fluids can be a 0.1 percent salt water solution, commercial mixes such as Gatorade or Quick Kick, or a combination of these and fresh water;
- Establishment of work regimen that will provide adequate rest periods for cooling down. This may require additional shifts for workers or earlier/later work schedules;
- Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments;
- All breaks are to be taken in a shaded rest area;
- Employees will remove impermeable protective garments during rest periods;
- Employees will not be assigned other tasks during rest periods; and
- To prevent heat stress, all employees will be informed of the importance of adequate rest, acclimatization, proper diet, health hazards, recognition of heat illness, and first aid.

Because the incident of heat stress depends on a variety of factors, all workers, event those not wearing protective equipment, should be monitored. For workers wearing permeable clothing (e.g., standard cotton or synthetic work (clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress. If the actual clothing worn differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly.

Due to the added stresses placed upon personnel by certain PPE ensembles, the ACGIH standard for heat stress cannot be used for workers wearing semipermeable or impermeable ensembles. The following method may be used to monitor for and prevent heat stress in workers wearing PPE at temperatures at or above 70°F:

- Measure worker's heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.
 - If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same;
 - If the heart rate still exceeds 100 beats per minute at the next rest period, shorten the following work cycle by one-third.
- Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).

- If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period;
- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third;
- Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

Body water loss may also be monitored by measuring employee weight on a scale accurate to ± 0.25 lb at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, is nude. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and level of physical work. The length of work cycle will be governed by frequency of the required physiological monitoring. Suggested frequencies for monitoring are provided in Table 7.4.

7.6 Cold Stress Monitoring

Cold stress may be of concern, especially when a wind-chill-adjusted temperature of 10°F or less is expected. To control cold stress:

TABLE 7.4

**SUGGESTED FREQUENCY OF PHYSIOLOGICAL MONITORING
FOR FIT AND ACCLIMATIZED WORKERS^a**

ADJUSTED TEMPERATURE ^b	NORMAL WORK ENSEMBLE ^c	IMPERMEABLE ENSEMBLE
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5 (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

a For work levels of 250 kilocalories/hour

b Calculate the adjusted air temperature ($t_{a\ adj}$) by using this equation $t_{a\ adj} \text{ } ^\circ\text{F} = t_a \text{ } ^\circ\text{F} + (13 \times \% \text{ sunshine})$. Measure air temperature (t_a) with standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

c A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

- Shade workers from radiant heat as much as possible;
- Maintain workers body fluids at normal levels;
- Encourage workers to be physically fit;
- Use cooling vests or airline vortexes when appropriate;
- Train workers to recognize heat stress symptoms.

- Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling, causing death. Areas of the body which have high surface-area-to-volume ratios such as fingers, toes, and ears, are the most susceptible;
- Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F;
- As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration soaked;
- Local injury resulting for cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:
 - Frostbite nip or initial frostbite: characterized by sudden blanching or whitening of skin;
 - Superficial frostbite; skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient;
 - Deep frostbite: tissues are cold, pale, and solid; this is an extremely serious injury;
 - Systemic hypothermia is caused by exposure to freezing and rapidly dropping temperature. Its symptoms are visually exhibited in five stages: (1) shivering, (2) apathy, listlessness, sleepiness, and sometimes rapid cooling of the body to less than 95°F, (3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate, (4) freezing of the extremities, and finally, (5) death;
- Thermal socks, long cotton or thermal underwear, hard hat liners and other cold weather gear can aid in the prevention of hypothermia; and
- Blankets, warm drinks (other than caffeinated coffee) and warm break areas are essential.

In addition to the cold stress measures outlined above, personnel will be briefed on the dangers of cold stress and frostbite, and will be monitored during all rest breaks and field activities for signs of hypothermia or frostbite. Self-monitoring and co-worker monitoring (i.e., buddy system) will also be encouraged.

8.0 SITE CONTROL

A general description of site control measures to be employed during the Quadrant II RFI is presented in Section 4c and 4d of the GHASP.

As described in the GHASP, work areas within or near each MMES unit will be divided into an exclusion zone, a contamination reduction corridor (decontamination zone), and a support zone. Access to contaminated work areas will be restricted to persons authorized by MMES ESH. A daily roster containing the date, the person's name, the person's signature, organization, the time of entry, and the time of exit will be kept of all persons working in such areas. Any visitors to the area must present proper identification and be authorized to be on site. Visitors must comply with all aspects of the HASP.

The HSO shall identify those work areas which visitors/personnel are authorized to enter, and enforce site control measures.

8.1 Zone 1: Exclusion Zone

A visually defined exclusion zone will be established around each work area in which certain RFI tasks are to be performed, and will be of sufficient size to contain all work activities and

resultant waste productions. The perimeters of the exclusion zone will be defined with barricade tape, or barricades in order to restrict access within the plant security fence. Outside the security fence, metal fencing with lockable gates will be erected to surround hazardous waste sites and prevent entry by unauthorized personnel. Visitors are not permitted to enter exclusion zones. Work tasks which shall require the establishment of an exclusion zone around the proposed work area(s) include:

- Soil boring and sampling;
- Monitoring well installation;
- Monitoring well sampling; and
- Holding pond sediment sampling.

Due to the relatively low risk and limited potential for potentially hazardous waste generation, the RFI work tasks not listed above shall not require establishment of a formal exclusion zone. However, all SOPs and exclusion zone prohibitions will remain in effect during performance of these work tasks.

8.2 Zone 2: Contamination Reduction (Decontamination) Zone:

The contamination reduction zone (CRZ) provides a transition between the exclusion zone and the support zone. A decontamination station will be established within the CRZ, and will serve as the sole entry and exit point for the exclusion

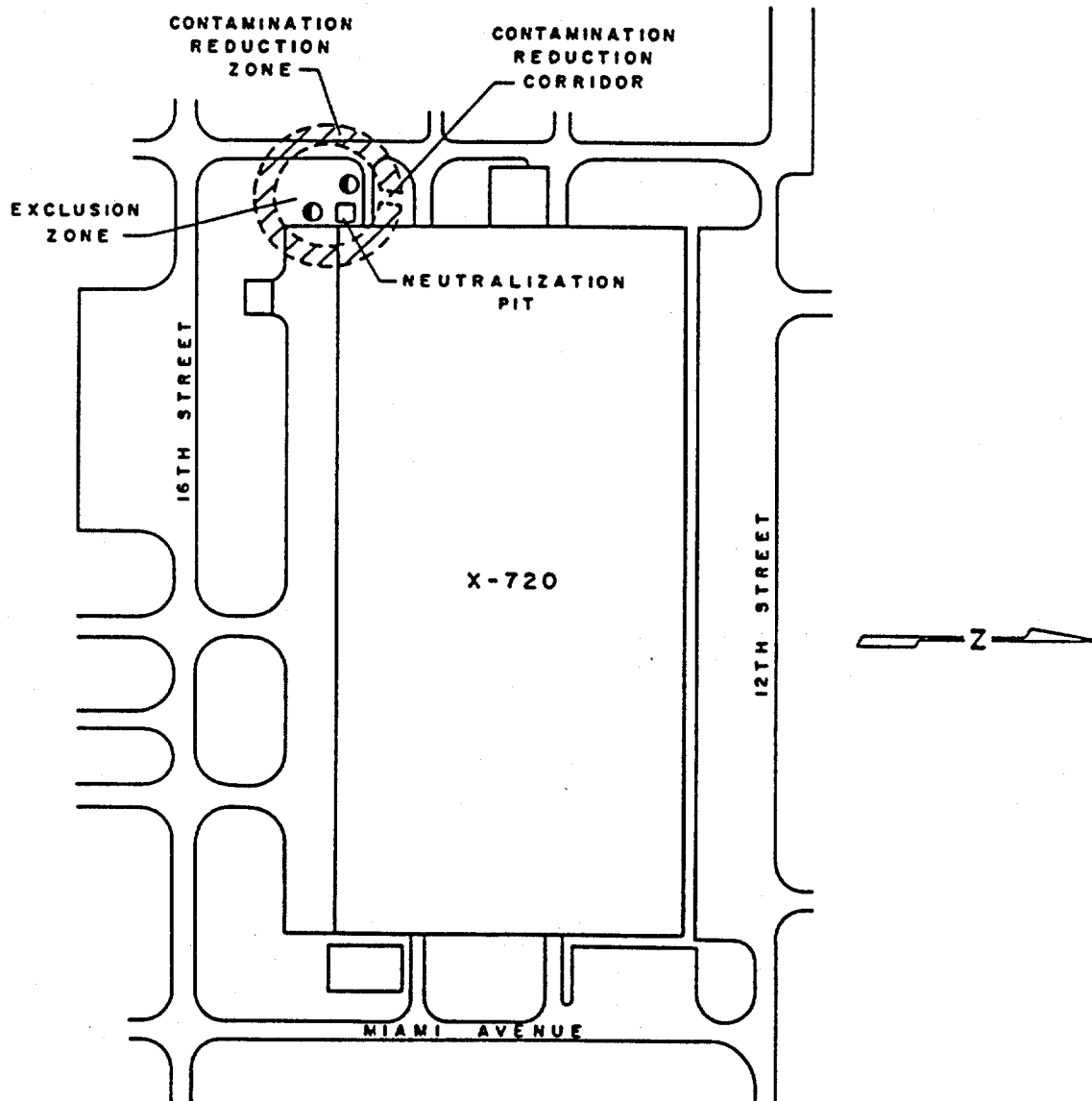
zone. The CRZ decontamination station will contain facilities for the decontamination of personnel and portable equipment, as outlined in Section 9. A steam cleaning pad for the decontamination of vehicles, drilling equipment, etc. will be established at a location readily accessible to the units under investigation. Equipment decontamination procedures are described in Section 9. Visitors are not permitted to enter decontamination zones.

8.3 Zone 3: Support Zone:

The support zone is situated in clean areas outside of the CRZ, where the chance to encounter hazardous materials/conditions is minimal. The general relationships among the site work zones is depicted in Figure 8.1.

Visitors may enter support zones under the following conditions:

- Visitors must be under continuing escort by personnel qualified in at least 24 hours of health and safety training for hazardous waste sites;
- Visitation occurrence is irregular or intermittent and for short-term entry only; or
- Purpose of visitation is observatory in nature or involves the performance of incidental, non-hazardous tasks.



SECT:

REPRESENTATIVE SITE WORK AREAS,
X-720 NEUTRALIZATION PIT

FIGURE
8.1

8.4 Communications

Due to the widely scattered locations of the work area, and the nature of the tasks to be performed, line of site communication between the command post and field personnel will not be possible. Communication systems to be employed during RFI activities will consist of two-way radios and in-plant telephone system, affording communication between field personnel, command post support staff, and plant emergency response personnel. MMES escorts will provide field personnel with the locations of accessible in-plant telephones. The following hand signals also will be employed by field personnel in emergency situations:

<u>Signal</u>	<u>Definition</u>
Hands clutching throat	Out of air/can't breath
Hands on top of head	Need assistance
Thumbs up	OK/I'm alright/I understand
Thumbs down	No/negative
Arms waving upright	Send backup support
Grip partners wrist	Exit area immediately

8.5 Quadrant II RFI Safe Work Practices

Safe work practices (SWP's) to be followed by field personnel within the hazardous waste operation areas are listed in Section 5 and 8 of the GHASP, and are presented below.

- All field personnel, inspectors, etc. will enter designated exclusion zones only through the contamination reduction corridor (CRC). All personnel leaving an exclusion zone must exit the exclusion zone through the CRC and pass through the CRC decontamination procedure;
- Only those vehicles and equipment required to complete work tasks will be permitted within an exclusion zone (i.e., drilling rigs, support trucks, etc.). All nonessential vehicles will remain within the support zone;
- Containers (i.e., drums, hoppers, etc.) will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport;
- All personnel will avoid contact with potentially contaminated substances. Walking through puddles or mud, or kneeling on the ground, should be avoided whenever possible;
- Equipment will not be placed on possibly contaminated surfaces;
- Field survey instrumentation (i.e., photovac TIP, personal air sampling pumps, radiation monitors, etc.) will be covered with plastic or similar covering to minimize the potential for contamination;
- Portable eyewash stations will be located in the restricted-access areas near work activities;
- Food and beverages will not be permitted or consumed in the exclusion zone or contamination reduction zone. Possession or use of tobacco products and the application of cosmetics are also prohibited in these areas;
- No matches or lighters will be permitted in the exclusion zone or contamination reduction zone;
- During RFI activities all personnel will be required to wash their hands and face before eating, drinking, smoking, or applying cosmetics;
- Contaminated protective equipment, such as respirators, hoses, boots, disposable protective clothing etc., will not be removed from the exclusion zone or decontamination zone until it has been cleaned, or properly packaged and labeled;

- All personnel will be required to field wash (hands and face) as a minimum at the end of their shift before leaving the job site. Hands and face will be washed during breaks;
- Employ the buddy system when performing any RFI field activity within a defined exclusion area; do not work within any exclusion zone without a coworker/partner;
- Field personnel must observe each other for signs of toxic exposure and heat/cold illness. Indications of adverse effects include, but are not limited to:
 - Changes in complexion and skin discoloration;
 - Changes in coordination;
 - Changes in demeanor;
 - Excessive salivation and pupillary response; or
 - Changes in speech pattern.
- Field personnel are cautioned to inform each other of non-visual effects of illness such as:
 - Headaches;
 - Dizziness;
 - Nausea;
 - Blurred vision;
 - Cramps; or
 - Irritation of eyes, skin, or respiratory tract.
- If any indications of radioactivity, explosivity or unusual conditions are observed, exit immediately and report to the HSO or project manager;
- All MMES plant security and operating policies will be followed in addition to these procedures.

8.5.1 Heavy Equipment

Backhoes and truck-mounted drilling equipment are among the types of heavy equipment to be used during the Quadrant II RFI. Heavy equipment can represent a substantial hazard to workers. In general, requirements for motor vehicles and material handling equipment are provided in the OSHA Construction Industry Standards

29 CFR 1926, Subpart O. The following SOPs are to be followed when heavy equipment is in use (drilling rigs, front end/backhoe loaders, etc.):

- Use common sense. Do not assume that the equipment operator is keeping track of your whereabouts. Never walk directly in back of, or to the side of, heavy equipment without the operator's knowledge;
- Hard hats, steel toe boots, and safety glasses are to worn at all times around heavy equipment. Other protective gear as specified in the health and safety plan is also applicable;
- Remain alert at all times;
- Maintain visual contact at all times;
- Establish hand signal communication when verbal communication is difficult. Determine one person per work group to give hand signals to equipment operators;
- Be aware of footing at all times;
- All heavy equipment shall have backup alarms of some type;
- Only qualified/licensed people are to operate heavy equipment;
- Use chains, hoists, straps, and any other equipment to safely aid in moving heavy materials;
- Use proper personal lifting techniques. Use your legs, not your back;
- Never walk directly in back of, or to the side of, heavy equipment without the operators' knowledge;
- Never use a piece of equipment unless you are familiar with its operation. This applies to heavy as well as light equipment (for example, chain saws);
- Pipe sections and other materials to be utilized during this project are extremely heavy. Make sure all precautions have been taken prior to the moving. Let the equipment, not your body, do the moving;

- Be sure that no underground or overhead power lines, sewer lines, gas lines, or telephone lines, will present a hazard in the work area;
- Keep all non-essential people out of the work area;
- Prohibit loose-fitting clothing or loose long hair around moving machinery;
- Keep cabs free of all non-essential items and secure all loose items;
- Instruct equipment operators to report to their supervisor(s) any abnormalities such as equipment failure, oozing liquids, unusual odors, etc.;
- When an equipment operator must negotiate in tight quarters, provide a second person to ensure adequate clearance;
- Implement an ongoing maintenance program for all tools and equipment. Inspect all tools and moving equipment regularly to ensure that parts are secured and intact with no evidence of cracks or areas of weakness, that the equipment turns smoothly with no evidence of wobble, and that it is operating according to manufacturer's specifications. Promptly repair or replace any defective items. Keep maintenance and repair logs;
- Store tools in clean, secure areas so that they will not be damaged, lost or stolen;
- Keep all heavy equipment that is used in the exclusion zone in that zone until the job is done. Completely decontaminate such equipment within the designated vehicle decontamination pad;
- Vehicles may not have cracked windshields or windows;
- Blades, buckets, dump bodies, and other hydraulic systems must be fully lowered when equipment is not in use;
- Parking brakes shall be engaged when equipment is not in use;
- Seatbelts must be provided in all vehicles having rollover protective structures (ROPS);
- With certain exceptions provided in Subpart O, all material handling equipment will be provided with ROPS;

- Equipment with an obstructed rear view must have an audible alarm that sounds when it is operating in the reverse direction (unless a spotter guides the vehicle operator);
- Material handling equipment that lacks a ROPS must not be operated on a grade, unless the grade can safely accommodate the equipment involved;
- A safety barrier will be used to protect workers whenever tires are inflated, removed, or installed on split rims;
- Heavy equipment will be inspected by the operator prior to the beginning of each work shift, and the HSO shall ensure the compliance to this regulation.

8.5.2 Trenching and Confined Space Entry

Test pits-trenches and excavations may pose a physical hazard to personnel. Fatalities resulting from poor trenching practices occur regularly in the United States. These accidents are predictable in the statistical sense and almost completely avoidable. All trenching and excavation work will comply with the requirements given in 29 CFR 1926, Subpart P; PORTS SPP M-13, "Excavation Permit"; and PORTS SPP M-3, "Hazardous Work Permits."

Test pits will be employed to assess subsurface conditions along former X-701 to X-705 process lines. Due to the potential hazardous associated with test pit entry (sidewall instability, toxic or combustible gas accumulation; etc.) test pit entry is strongly discouraged and will be avoided, where possible. The following requirements will be followed, in addition to the

regulations mentioned above during test pit excavation and work activities.

- Whenever possible, workers will not go into trenches or test pit excavations;
- Test pits deeper than five feet will be securely shored or the walls will be sloped at an angle well below the angle of repose of the surrounding soils. The water content of the soil, the soil type, degree of compaction of the soil, superimposed loads and vibration can effect the stability of a trench or excavation;
- Test pits will be inspected by a competent person before workers enter them. A confined space entry permit system will be employed to prevent workers from entering unsafe trenches. The entry permit will be issued only after characterization of the test pit atmosphere for toxic and combustible gases, percent oxygen, radiological hazards, and physical hazards. Monitoring will be performed continuously while personnel are within the test pit;
- The protective level for entry personnel will be based upon results of air monitoring; however, the minimum acceptable protection level will be full level C, with chemical resistant splash suit;
- Personnel entering the test pit will be equipped with a harness and lifeline meeting OSHA standard 29 CFR 1926.104;
- The atmosphere around the test pit and excavated soils will be characterized for combustible gases, percent oxygen, radiological hazards, and volatile organic compounds;
- Water will not be allowed to accumulate in trenches and excavations;
- Spoils will be stored at least two feet from the edge of the trench or excavation;
- Vibration sources or heavy objects (e.g., backhoes) will not be situated on the edge of a pit unless steps are taken to ensure the stability of the trench wall;
- Stop logs or other barriers will be used to prevent vehicles from rolling into an open trench or excavation.

All employees required to enter into confined spaces shall observe requirements specified in ANSI Z117.1-1977 (or the latest revision thereof) and PORTS SPP H-53, "Confined Space Program." Prior to entry, personnel shall have satisfactorily completed a confined space training program. Atmosphere testing for oxygen deficiency, combustible gases and toxic agents will be required. High risk entries require issuance of a hazardous work permit (HWP) by the Portsmouth Facility custodian prior to job activities.

8.5.3 Electrical

All electrical wiring used during the Quadrant I RFI activities will satisfy the requirements of 29 CFR 1926, Subpart K, and any applicable local electric codes. Some specific electrical safety requirements follow:

- All wiring will be done by a licensed electrician;
- All extension cords must have functional grounding conductors;
- All equipment that is not "double insulated" must have a functional grounding conductor;
- All electrical cords must be in good condition;
- In lieu of a documented "assured equipment grounding conductor program," ground fault protected circuits can be utilized;

- Electrical cords and power tools will be inspected by the HSO prior to use. Workers will inspect their power tools and cords.

8.5.4 Trip and Fall Hazards

Workers will be apprised of any potential trip hazards through regular health and safety meetings.

Whenever possible, trip and fall hazards will be eliminated or clearly identified with yellow "caution" tape. Impalement hazards to workers will be neutralized as soon as they are identified.

8.5.5 Utility and Power Line Clearance

Trenching and excavating in a given area will not begin until the PORTS Civil Engineering Department has approved the location and has issued an Excavation Permit (per SPP M-13). Trenching and excavating will proceed with caution in any area that historical data or appropriate instrument surveys (e.g., magnetometer or ground penetrating radar) indicate the possible presence of buried hazardous materials.

The following clearance distances will be observed between equipment and energized power lines:

<u>Voltage</u>	<u>Working Clearance (Ft)</u>	<u>Transit Clearance (Ft)</u>
50 kV or less	10	4
50 to 345 kV	10 ft + 0.4 in. per kV	10
345 to 750 kV	10 ft + 0.4 in. per kV	16

If drilling is required near power lines arrangements can be made to have the power turned off. Approval is made through the Construction Engineering Department which shall issue an Electrical Work Permit (per SPP M-4).

8.5.6 Noise Protection

Workers will be protected from excessive noise exposure through equipment maintenance, noise monitoring, and hearing conservation programs which comply with 26 CFR 1910.95. The daily equipment inspection will include the exhaust system; perforated exhaust pipes and mufflers will be replaced as they are discovered. Noise level surveys in work areas and around equipment will be performed regularly and documented.

Hearing protective equipment will be required whenever continuous noise levels equal or exceed 85 dBA (slow meter response) and/or impulse/impact noise exceeds current ACGIH TLVs or OSHA 1910.95.

8.5.7 Illumination

While work is in progress, areas accessible to employees will be illuminated not less than the following intensities:

MINIMUM ILLUMINATION INTENSITIES

Foot-candles

Areas or operations

- | | |
|---|--|
| 5 | General site areas |
| 3 | Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas. |
| 5 | Indoors: Warehouse, corridors, hallways, and exitways. |

Foot-candles

Areas or operations

- | | |
|----|---|
| 5 | Tunnels, shafts, and general underground work areas. (Exception: Minimum of 10 foot-candles is required at tunnel and shaft heading during drilling mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading.) |
| 10 | General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.) |
| 30 | First aid stations, infirmaries, and offices. |
-

8.5.8 Sanitation

Provision of potable water, drinking cups, non-potable water, toilet facilities, washing facilities and other sanitation requirements will be in compliance with specifications of OSHA 1910.120 (n).

8.5.9 Bodies of Water

When working over or near water OSHA standard 1926.106 shall be observed. Requirements include:

- Employee shall be provided with U.S. Coast Guard approved life jacket or work vest;
- Inspection of life jacks and vests shall be conducted prior to use;
- Approved Rescue Devices must be readily available;
- An approved Life Saving Skiff must be available.

8.5.10 Site Housekeeping

Construction debris shall be handled in accordance with OSHA 1926.25.

8.5.11 Enforcement

The SSO will be responsible for enforcement of SWPs and SOPs during RFI field activities. Personnel who fail to follow these practices will face disciplinary action up to and including dismissal from the job site.

A list of SOPs will be distributed to all personnel taking part in the RFI field program, and will be conspicuously posted at the command post (X-800, or SWEC building). At least one copy of this site-specific HASP will be available at each work site. A review of SOPs and any necessary changes in these practices will be performed at the beginning of each day by the SSO.

8.5.12 Complaints

A DOE Form 5480.2 (12/86) poster shall be posted at command post. Employees are encourage to report to the HSO either directly or through their authorized employee representative, any conditions or practices which they consider detrimental to their health or safety or which they believe are in violation of applicable health and safety standards. Such complaints may be made orally or in writing. The contractor will also have available in the workplace DOE Form F-5480.4, "Occupational Safety and Health Complaint Form," to be used in reporting violations.

Employees who believe that an imminent danger exists that threatens human or environmental health, death or serious physical harm, are encouraged to bring this matter to the immediate attention of the HSO for resolution. In the event of the inadequate corrective action, the employee and/or authorized representative may also contact the local agency having jurisdiction, the contractor's project office, or MMES ESH by telephone or set forth with reasonable particularity the basis for their request for an immediate inspection. Competent medical personnel, which may include a physician, will evaluate the symptoms of illnesses that could seriously affect a worker's health and safety.

8.6 Quadrant II RFI Safe Operating Procedures

Safe operating procedures for drum loading and handling and drilling operations are presented below. These procedures are to be followed by RFI personnel, and are intended to be used in conjunction with the SWP's given in Section 8.5.

8.6.1 Drum Handling Procedures

Based upon the type of activities to be performed during the Quadrant II RFI, and the existing information on the units to be investigated (i.e., potential contaminants, past waste management practices, etc.), the potential for encountering buried drums

which might contain potentially hazardous substances in remote. The principal use of drums during the Quadrant II RFI will be to contain contaminated drill cuttings (soil) and fluids evacuated from monitoring wells.

The work practices outlined below shall be employed by RFI personnel to reduce the potential for injury or accidents resulting from the use and handling of drums.

Two types of drums may be used to contain contaminated soil and fluids; whole-lid-removable drums for containing contaminated soils and PPE, and bung-type drums for containing fluids. Empty drums will be handled and transported in a manner to prevent accidental puncture, denting, or shifting in transit. Empty drums will be blocked, wedged, or strapped down during transit.

The filling of drums will be performed in a manner to minimize contamination of the outer drum surfaces. Drums containing bulk soil shall be filled no higher than between two to four inches from the top of the drum. Immediately upon filling a drum with soil, the lid and securing ring shall be positioned and secured. Potentially contaminated soil will be removed from the other surfaces prior to drum closure, in order to minimize exposure of MMES and RFI personnel to contaminants. Where possible, whole-lid-removable drums will be equipped with plastic drum liners prior to filling.

Drums being filled with potentially contaminated fluids will be under constant surveillance during the filling operations; drums are not to be left unattended during filling, in order to prevent overfilling. Absorbent material shall be kept near the work area, and readily available to RFI personnel. Bung-type fluid-containing drums will be tightly closed after filling. Fluid levels in bung-type drums should not be closer than two inches from the top of the drum opening.

Monitoring of drill cuttings and aquifer fluids for radioactive and volatile organic chemical contamination will be performed while drums are begin filled, and prior to drum handling. Field survey monitors and action levels are outlined in Section 7.3. The minimum level of protection to be work by personnel during drum filling and sealing is modified level D protection. PPE requirements shall be based upon the results of environmental surveillance, and are outlined in Section 5.1.

Drums containing potentially contaminated soil or fluid will be labelled so to identify drum contents and potential contamination hazards. Hazardous waste placards meeting ANSI Z129.1-1988 and OSHA 29 CFR 1910-1200 standards shall be placed in a conspicuous location upon each drum following drum closure. Material Safety Data Sheets for potential contaminants which may be encountered in soils or aquifer fluids will be available for review in the command post (XT-800 buildings).

The handling and storage of drums containing potentially contaminated soil and fluids, and ultimate disposal of drum contents will be performed by PORTS, in accordance with PORTS, DOE, and all applicable Federal and State regulations. Should filled and sealed drums require movement by Quadrant II RFI personnel, mechanical devices, such as fork lifts, drum grapple-equipped fork lifts, hand trucks, or drilling rig winch shall be employed, to prevent physical injury due to potential exposure or the extreme weight of filled drums.

8.6.2 Drill Rig Operations

Specific requirements for drilling, soil sampling, well installation, well development and equipment to be used in performing these activities are presented in the Quadrant II RFI Work Plan, Revisions to the Quadrant II RFI Work Plan, and in the Environmental Surveillance Procedures document (ESP 600). All drilling, soil sampling, and well installation activities will be performed in accordance with these requirements, and the health and safety requirements outlined within this document.

The first line of defense from injuries resulting from the use of drilling equipment is the employment of trained and experienced drill operators (driller) and support personnel (helpers) following the safe work practices outlined in Section 8.5. The following procedures shall be employed by drilling

crews, as enforced by the HSO, during drilling and well installation activities.

The minimum drilling crew to be employed during the Quadrant II RFI will consist of a trained and experienced driller and helper. Additional personnel shall include a drilling inspector (geologist), and an escort. Drilling will not commence unless both a driller and helper are present.

The minimum protective equipment to be employed by the drilling crew shall consist of a hard hat, steel toe and shank work boots, safety glasses or goggles, and protective gloves. PPE to be used during the Quadrant II RFI are outlined in Section 5.1.

Prior to mobilization into and setup over a drilling location, check for any overhead or underground utilities. Approval of drilling locations is obtained through the Construction Engineering Department. Observe all required clearances from overhead lines, as described in Section 8.5.5.

Prior to drilling startup, and each morning thereafter the driller shall conduct a thorough inspection of the drilling rig for any defects or unsafe conditions such as:

- Leaking fuel or hydraulic lines or fittings;
- Inoperable or poorly responding controls or equipment;

- All guards or safety devices are operational or are in place over rotative machinery, as required by OSHA 29 CFR 1926;
- All wire ropes, slings, clevises, and other lifting equipment is in satisfactory conditions and is rated for the work to be performed (OSHA 29 CFR 1926.550).

Any defects identified during the inspection shall be corrected prior to startup of drilling.

Timbers should be used as necessary to aid in stabilizing and levelling the drilling rig at a drilling location. However, the use of timbers to level a rig should not result in an unstable working platform. Site grading may be required under these circumstances.

Extreme care must be employed during the addition or removal of augers and/or casing and startup of rotating drilling equipment (hollow-stem augers, rotary tables, cathead, etc.), due to the potential of injury or death from being caught or pinched in drilling equipment. The use of verbal commands, hand signals, and line-of-sight conformation by the drilling crew shall aid in avoiding these type of accidents.

9.0 DECONTAMINATION

Decontamination is the process of removing or neutralizing contaminants from personnel or equipment. When performed correctly, decontamination protects the worker from contaminants that may have accumulated on PPE, vehicles, tools, and other equipment and serves as the principal means of preventing the transport of potentially harmful materials into unaffected areas.

All personnel performing work tasks in an exclusion zone must pass through the decontamination procedure established at each work site, regardless of work task or protection level used. All drilling equipment, vehicles and tools used within the exclusion zone must likewise undergo decontamination.

Decontamination will take place within a Contamination Reduction Corridor (CRC), which will serve as the sole entry and exit point between the exclusion zone and safety zone at each work site.

9.1 Personnel Decontamination

Personnel decontamination will be completed according to the guidance given in the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. Personnel and personnel produced equipment will be decontaminated using water or

a mixture of detergent and water. Liquid and solid wastes produced during decontamination will be collected and disposed of properly. Prior to leaving this zone, workers will be frisked for radioactive contamination.

The following maximum decontamination procedure may be employed for those Quadrant II sites requiring level C and modified level C protection:

- Gross Contamination Removal

Remove any loose soil from PPE and any equipment. A brush may be used to remove loose material provided dust generated is minimized.

- Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination.

Equipment: various size containers
 plastic liners
 plastic drop cloths

- Station 2: Boot Cover and Glove Wash

Scrub outer boot covers (if used) and gloves with decon solution or detergent/water.

Equipment: container (20-30 gallons)
 detergent water
 2-3 long-handle, soft-bristle scrub
 brushes

- Station 3: Boot Cover and Glove Rinse

Rinse off decon solution from Station 2 using copious amounts of water. Repeat as many times as necessary.

Equipment: Container (30-50 gallons)
or
high-pressure spray unit
water
2-3 long-handle, soft bristle scrub
brushes

- Station 4: Tape Removal

Remove tape around boots and gloves and deposit in container with plastic liner.

Equipment: container (20-30 gallons)
plastic liners

- Station 5: Boot Cover Removal

Remove boot covers and deposit in container with plastic liner.

Equipment: container (30-50 gallons)
plastic liners
bench or stool

- Station 6: Outer Glove Removal

Remove outer gloves and deposit in container with plastic liner.

Equipment: container (20-30 gallons)
plastic liners

- Station 7: Suit/Safety Boot Wash

Thoroughly wash splash suit and safety boots. Scrub with long-handle, soft-bristle scrub brush and copious amounts of decon solution or detergent/water. Repeat as many times as necessary.

Equipment: Container (30-50 gallons)
detergent/water
2-3 long-handle, soft-bristle scrub
brushes

- Station 8: Suit/Safety Boot Rinse

Rinse off decon solution or detergent/water using copious amounts of water. Repeat as many times as necessary.

Equipment: container (30-50 gallons)
high-pressure spray unit
water
2-3 long-handle, soft-bristle scrub
brushed

- Station 9: Cartridge or Mask Change

If worker leaves exclusion zone to change cartridges (or mask), this is the last step in the decontamination procedure. Worker's cartridges are exchanged, new outer gloves and boots covers donned, and joints taped. Worker returns to duty.

Equipment: cartridges (or mask)
tape
boot covers
gloves

- Station 10: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

Equipment: container (30-50-gallons)
plastic liners
bench or stool
boot jack

- Station 11: Splash Suit/Disposable Coverall Removal

With assistance of helper, remove splash suit or disposable coveralls. Deposit in container with plastic liner.

Equipment: container (30-50 gallons)
bench or stool
liner

- Station 12: Inner Glove Wash

Wash inner gloves with decon solution or detergent/water that will not harm skin. Repeat as many times as necessary.

Equipment: decon solution
or
detergent/water
basin or bucket

- Station 13: Inner Glove Rinse

Rinse inner gloves with water. Repeat as many times as necessary.

Equipment: water
basin or bucket
small table

- Station 14: Facepiece Removal

Remove facepiece. Avoid touching face with gloves. Deposit facepiece in container with plastic liner.

Equipment: container (30-50 gallons)
plastic liners

- Station 15: Inner Glove Removal

Remove inner glove and deposit in container with plastic liner.

Equipment: container (20-30 gallons)
Plastic liners

- Station 16: Frisking Station

Scan personnel for the presence of radioactive material which may remain on skin or clothing. If radioactive materials are detected at unacceptable levels on personnel after decontamination, notify the Plant

Emergency Director to obtain the aid of a health physicist.

- Station 17: Field Wash

Shower if highly toxic, skin-corrosive or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment: water
 soap
 tables
 wash basins/buckets
 field showers

- Station 18: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

A general layout for maximum level C decontamination is shown on Figure 9.1. The minimum level C decontamination layout which may be used is depicted on Figure 9.2.

The following maximum decontamination action procedures may be used for those Quadrant II sites requiring modified level D protection:

- Gross Contamination Removal

Remove any loose soil from PPE and equipment. A brush may be used to remove loose material provided the generation of dust is minimized.

- Station 1: Segregated Equipment Drop

Deposit equipment used on-site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths or in different

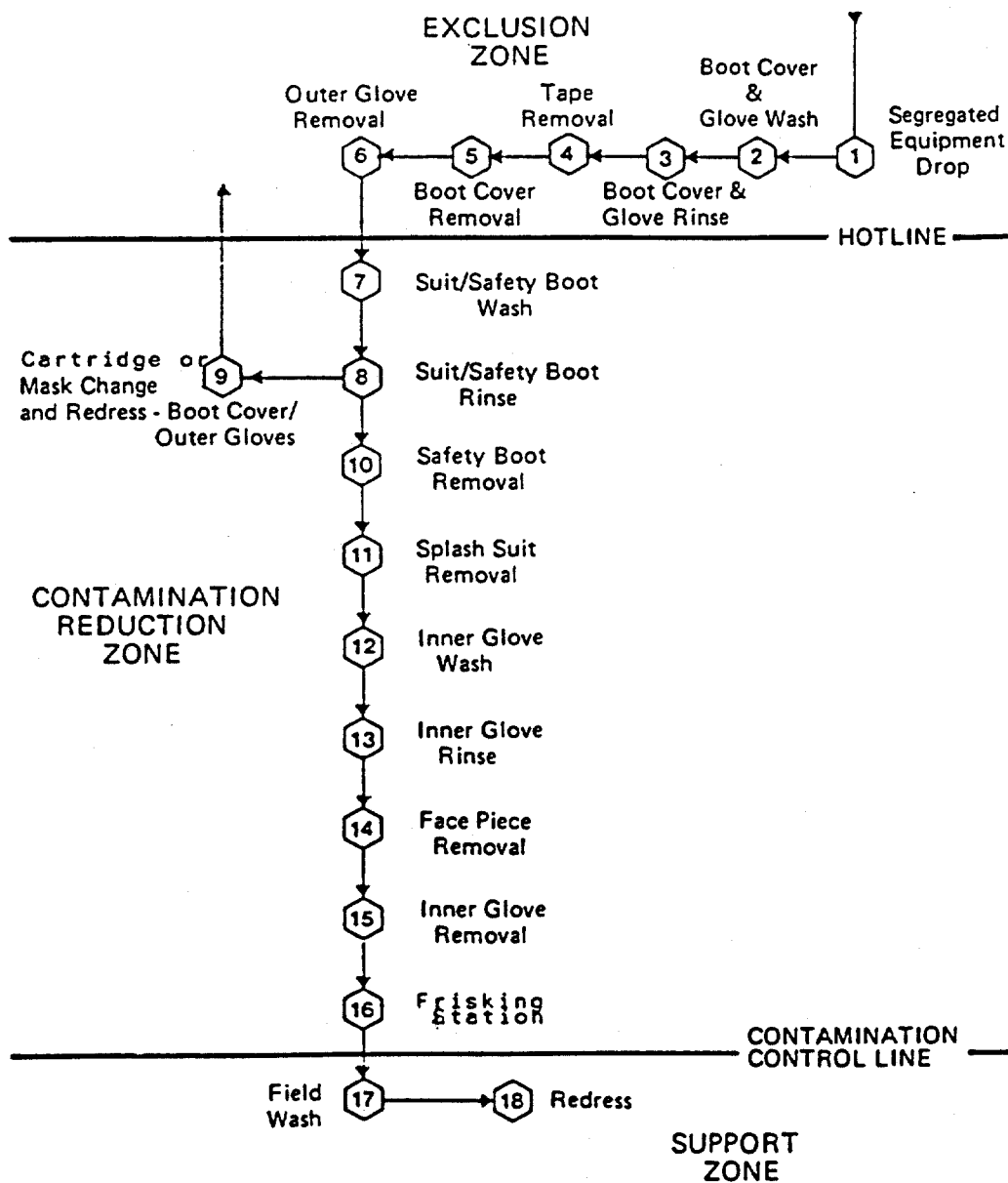


FIGURE 9.1:

Maximum Decontamination Layout: Full Level C Protection

From: NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, 1985

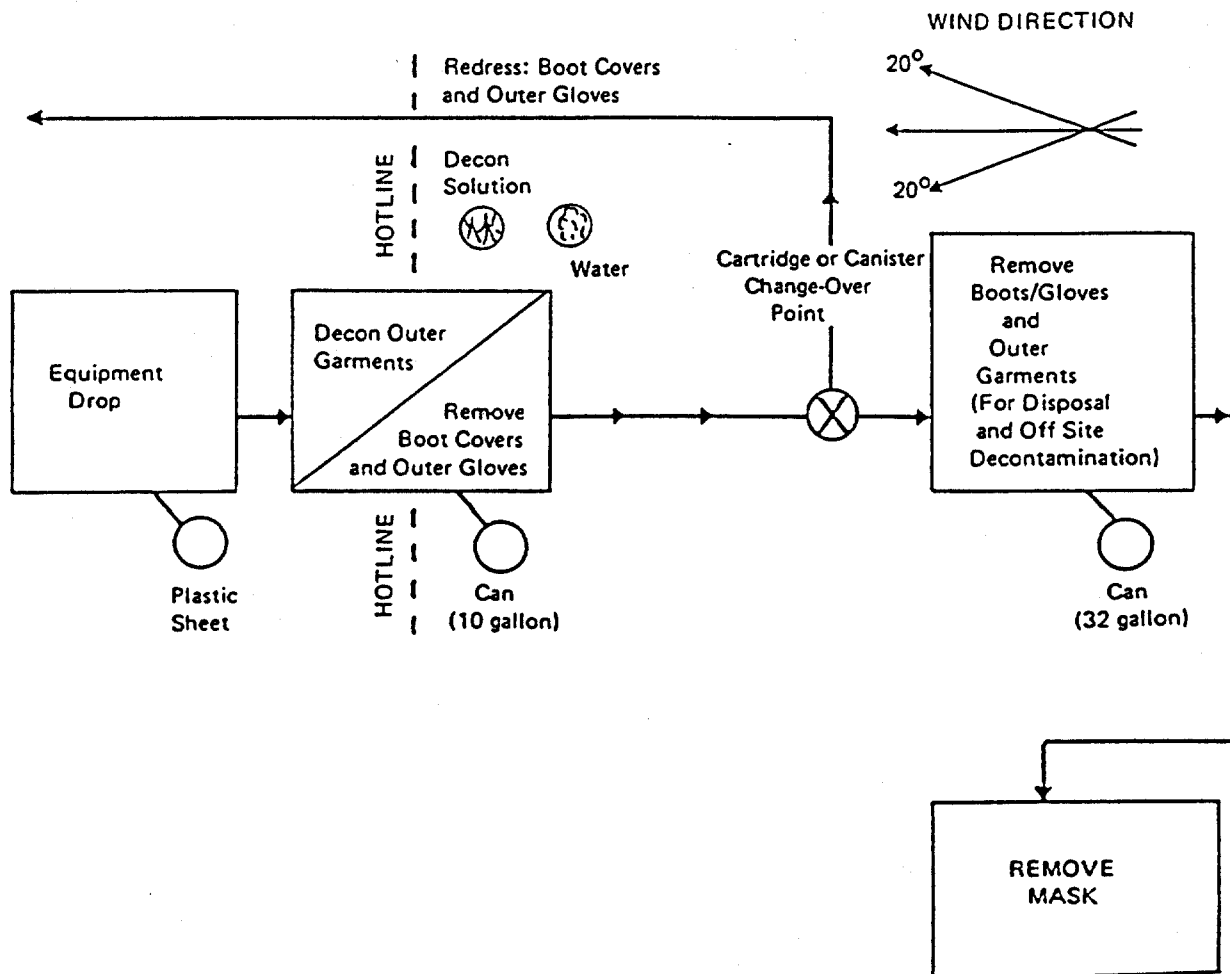


FIGURE 9.2:

Minimum Decontamination Layout: Modified Level C Protection

From: NIOSH Occupational Safety and Health Guidance Manual for
Hazardous Waste Site Activities, 1985

containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the possibility of cross-contamination.

Equipment: various size containers
plastic liners
plastic drop cloths

- Station 2: Boot and Glove Wash

Scrub outer boots and gloves with decon solution or detergent/water.

Equipment: container (20-30 gallons)
detergent water
2-3 long-handle, soft-bristle scrub brushes

- Station 3: Boot and Glove Rinse

Rinse off decon solution from Station 2 using copious amounts of water. Repeat as many times as necessary.

Equipment: container (30-50 gallons) or
high-pressure spray unit
water
2-3 long-handle, soft-bristle scrub brushes

- Station 4: Safety Boot Removal

Remove safety boots and deposit in container with plastic liner.

Equipment: container (30-50 gallons)
plastic liners
bench or stool
boot jack

- Station 5: Disposable Coverall Removal

With assistance of helper, remove splash suit or disposable coveralls. Deposit in container with plastic liner.

Equipment: container (20-30 gallons)
plastic liners

- Station 6: Outer Glove Removal

Remove outer gloves and deposit in container with plastic liner.

Equipment: container (20-30 gallons)
plastic liners

- Station 7: Frisking Station

Scan personnel for the presence of radioactive material which may remain on skin or clothing. If radioactive materials are detected at unacceptable levels on personnel after decontamination, notify the Plant Emergency Director to obtain the aid of a health physicist.

- Station 8: Field Wash

Shower if highly toxic, skin-corrosive or skin-absorbable materials are known or suspected to be present. Wash hands and face if shower is not available.

Equipment: water
soap
tables
wash basins/buckets
field showers

- Station 9: Redress

Put on clean clothes. A dressing trailer is needed in inclement weather.

A general layout for modified level D decontamination is shown on Figure 9.3. Should site conditions warrant upgrading to protection levels A or B, the decontamination procedure will be upgraded accordingly, as shown on Figures 9.4 and 9.5. The extent of contamination (i.e., number of stations) at a given protection

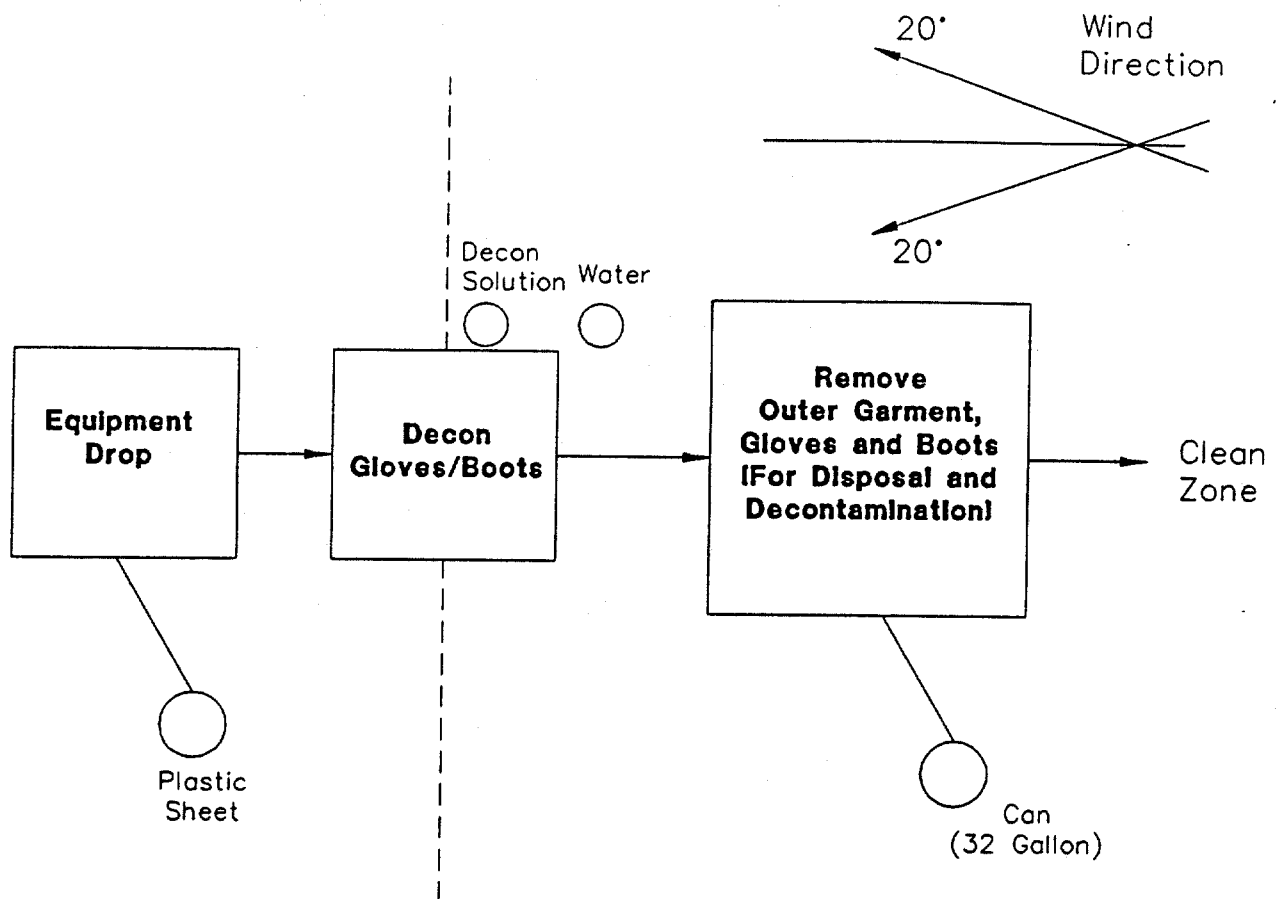


FIGURE 9.3:

Minimum Decontamination Layout: Modified Level D Protection

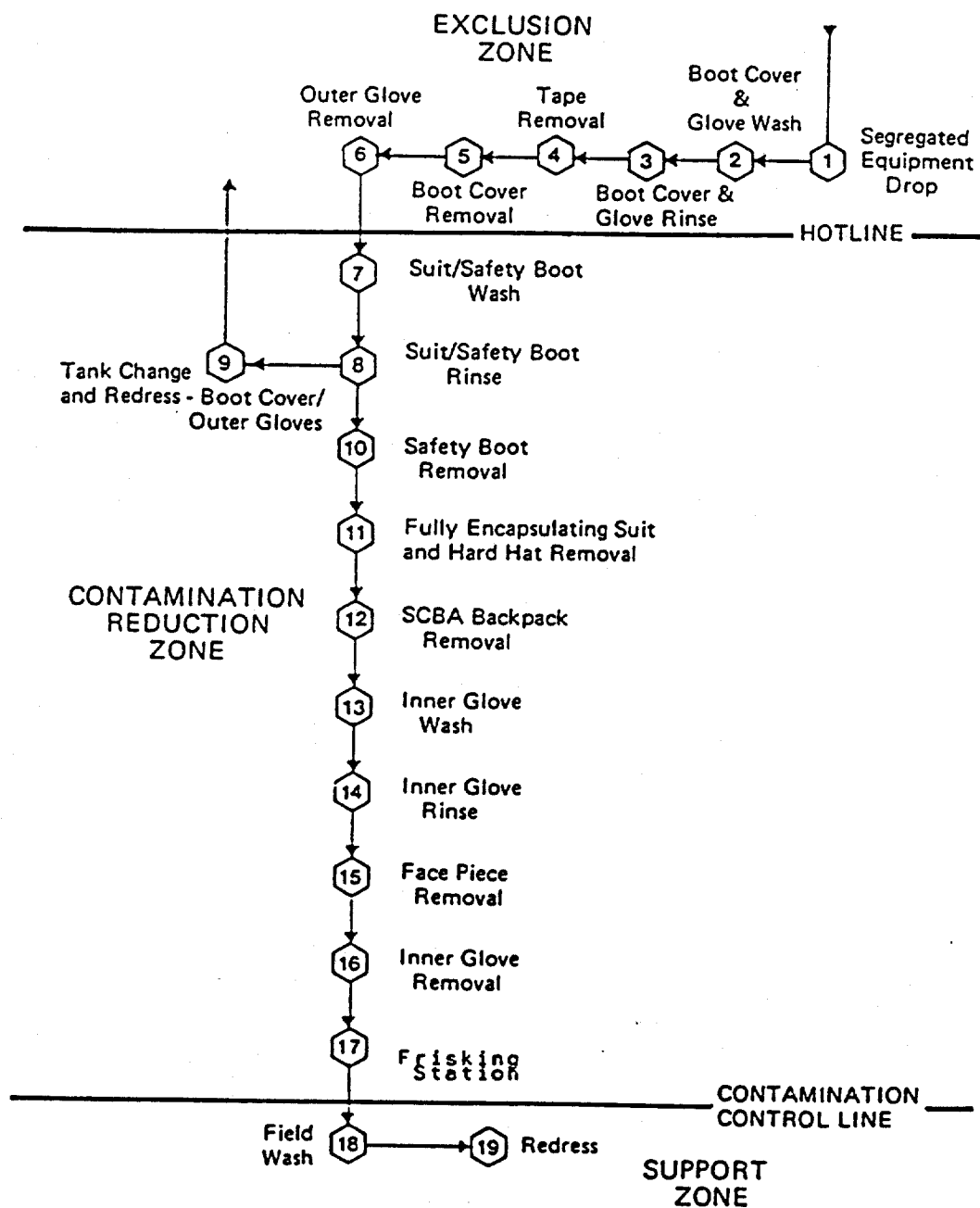


FIGURE 9.4:

Maximum Decontamination Layout: Full Level A Protection

From: NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, 1985

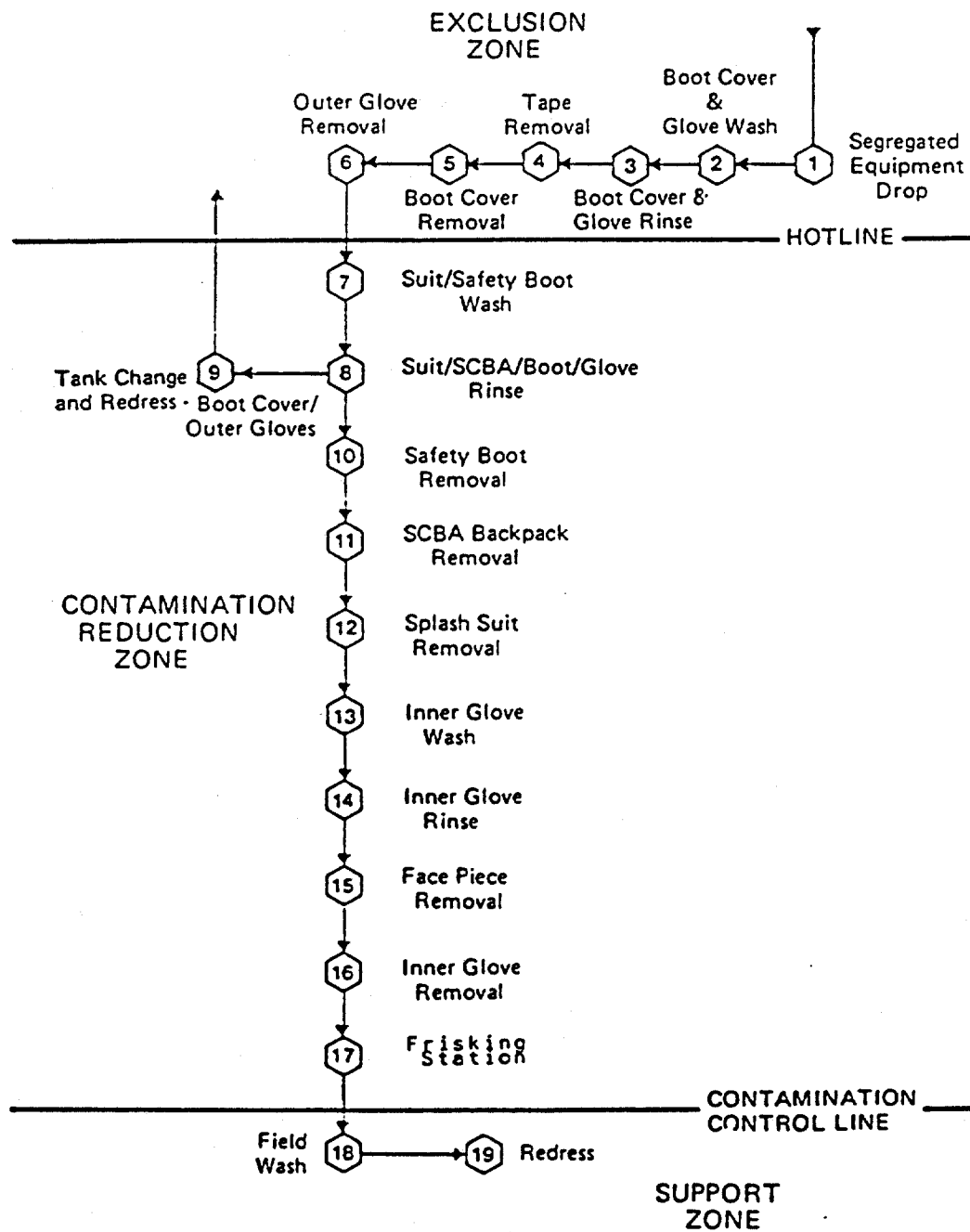


FIGURE 9.5:

Maximum Decontamination Layout: Full Level B Protection

From: NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, 1985

level may be up- or downgraded, based upon site-specific conditions.

9.2 Equipment and Vehicles

Field survey instrumentation used to monitor for environmental hazards during field activities will be washed/wiped with detergent-water solution until visibly free of contamination and rinsed with clean water. The devices will then be surveyed with a frisking meter for remnant radioactive materials, and removed to the safety zone for storage or maintenance. Protective covers or plastic will be employed to minimize contamination of field instrumentation.

Where possible, decontamination of tools, drilling rig, hollow stem augers, sampling equipment, vehicles, etc., will be performed in a designated decontamination area centrally located to the Quadrant I work sites. Minimum routine decontamination procedures for non-radioactive contaminants will consist of physically removing loose soil material from the vehicle or tool, following by steam cleaning. Rinsate samples will be collected for analysis of volatile organic compounds at a frequency of one sample per unit investigated.

Drilling or sampling equipment identified as being contaminated with radioactive soil or other media will not be

decontaminated as outlined above. Prior to removing contaminated equipment from the exclusion zone, MMES health physics department will be notified and the equipment will be relinquished to designated MMES personnel for decontamination. Maximum permissible residual radioactivity for vehicles and equipment presented on Table 9.1. Removal of contaminated materials from the exclusion zone will be performed under the direction of an MMES health physicist. Should routine decontamination procedures not be effective in removing nonradioactive contamination, a more severe method will be employed in accordance with ESP-901.

Every attempt will be made to reduce contamination on equipment and articles to levels that are low as reasonably achievable. Whenever possible, steam cleaning and the use of detergents and water will be used in place of solvents and chemical decontaminants. Solid and liquid wastes produced during decontamination will be collected for proper disposal.

TABLE 9.1.
ALLOWABLE RESIDUAL SURFACE CONTAMINATION
LIMITS FOR UNRESTRICTED RELEASE

NUCLIDE ^a	AVERAGE ^c (dpm/100 cm ²)	MAXIMUM ^{b,d} (dpm/100 cm ²)	REMOVABLE ^{b,e} (dpm/100 cm ²)
U-nat, U-235, U-238, and associated decay products	5,000 alpha	15,000 alpha	200 alpha (PORTS limit)
Transuranics, Ra-226, Ra-228 Th-230, Th-228 Pa-231	100	300	22
Ac-227, I-125, I-129, Th-nat, Th-232, Sr-90 Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except SR-90 and others noted above.	5,000 beta- gamma	15,000 beta- gamma	1,000 beta- gamma

- a Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.
- b As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
- c Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.
- d The maximum contamination level applies to an area of not more than 100 cm².
- e The amount of removable radioactive contamination per 100 cm² of the surface area should be determined by wiping the area with dry filter paper or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface area should be wiped. *

Source: US NRC Regulatory Guide 1.86, June 1974

10.0 EMERGENCY CONTINGENCY PLANNING

Procedures for response to on-site emergencies including MMES emergency alarms and existing chain-of-command are described in Section 11 and 12 of the GHASP and are discussed below.

The HSO shall be notified of any on-site emergencies and be responsible for ensuring that the appropriate procedures are followed. The following standard emergency procedures will be used by on-site personnel.

10.1 Injury in the Exclusion or Decontamination Zone

In the event of an injury in the exclusion or decontamination zone, all site personnel shall exit the exclusion zone and assemble at the decontamination line. The on-site inspector will evaluate the nature of the injury and the affected person should be decontaminated to the extent practical prior to movement to the support zone. Appropriate first aid will be initiated, and an immediate request will be made for an ambulance (if necessary) and the designated medical facility notified (if required). No persons will re-enter the exclusion zone until the cause of injury or symptoms is determined. Documentation requirements are outlined in Section 6.2.

10.2 Injury in the Support Zone

In the event an injury occurs in the support zone, the on-site inspector, HSO, and/or safety manager must be notified immediately. Appropriate first aid will be administered and, if necessary, the injured individual will be sent to the designated medical facility. If the injury does not affect the performance of site personnel, operations may continue. Documentation requirements are outlined in Section 6.2.

10.3 Fire/Explosion

In the event of a fire or explosion at the site, the PORTS fire department will be alerted and all personnel moved to a safe distance from the area. See section 10.5.1 for a list of emergency phone numbers.

10.4 Protective Equipment Failure

If any site worker experiences a failure or alteration of protective equipment that affects the protection factor, that person and his/her coworker(s) will immediately leave the exclusion zone. Re-entry to the exclusion zone will not be permitted until the equipment has been repaired or replaced.

10.5 Emergency Procedures at PORTS

Emergency phone numbers and directions to the nearest medical facility will be posted at conspicuous places in the support zone. It is the policy of MMES to maintain an emergency preparedness program to provide the maximum practicable protection for employees, DOE and DOE contractor personnel, members of the public, and property in the event of emergencies involving activities on the PORTS site. Because of the nature of the facility, visitors to PORTS are always accompanied by an escort. This escort will be familiar with emergency situation response, the locations of monitoring stations, etc. and can direct visitors should an emergency situation occur. The following information is provided in case of alarms or emergencies:

10.5.1 Reporting an Emergency

Any person discovering an emergency condition at an RCRA facility should immediately alert the Plant Emergency Director (PED) and the Plant Emergency Response Team by one of the following means:

- Dial 5555 on any phone. Give your name and all vital information to the answering parties. The Plant Emergency Squad will respond;
- Actuate a Red Fire Alarm Box - if possible wait nearby to provide the emergency squad with details of the emergency;

- Use the Plant Radio System to notify X-300 (plant control facility);
- Pick up a Red Emergency Phone. X-300 will answer. Give your name and details of the emergency.

After alerting the Plant Emergency Director and the Plant Emergency Response Team, the person discovering emergency should do whatever can safely be done to minimize the emergency.

In all emergencies, no matter how the alarm is initiated, it is important that the MMES Cascade Coordinator receives an initial request for the Emergency Response Team. The only way the MMES Coordination personnel would not be included in the initial alert sent in by one of the means above, would be because of a malfunction of their equipment. Any time an alarm is received by the Police or Fire Department and Cascade Coordination does not respond with immediate contact of Police and Fire Departments, it will be assumed that Cascade Coordination did not receive the alarm and it will be the responsibility of the Fire Department Captain or the Police Console Operator to pick up the Red Emergency phone and include the Cascade Coordinator in the initial alert.

10.5.2 Recognizing Emergency Alarms

- The steady sounding of sirens atop the X-330 and X-326 building is an Alert Signal listen for a public address announcement;